Chemical Engineering

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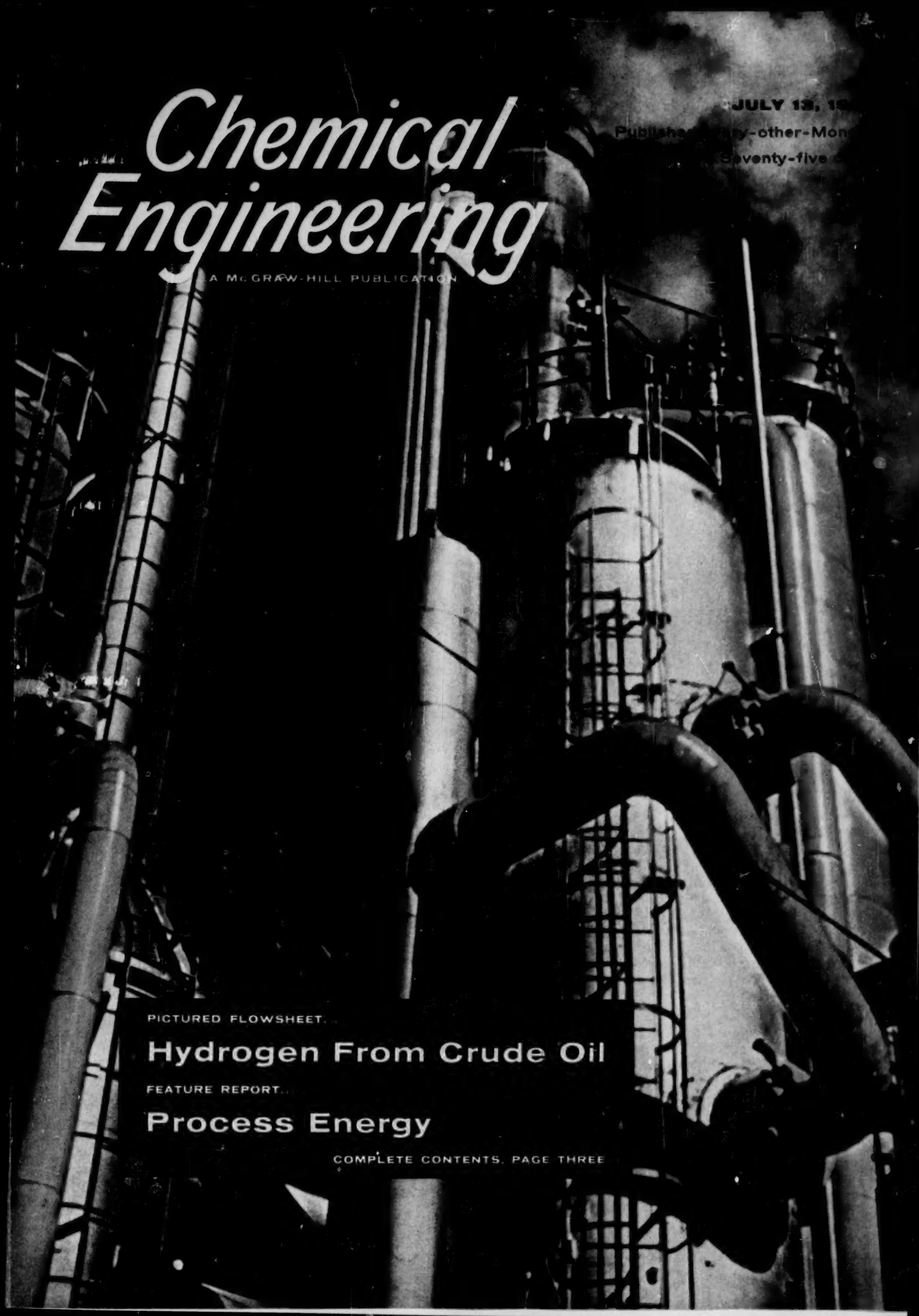

PICTURED FLOWSHEET

Hydrogen From Crude Oil

FEATURE REPORT

Process Energy

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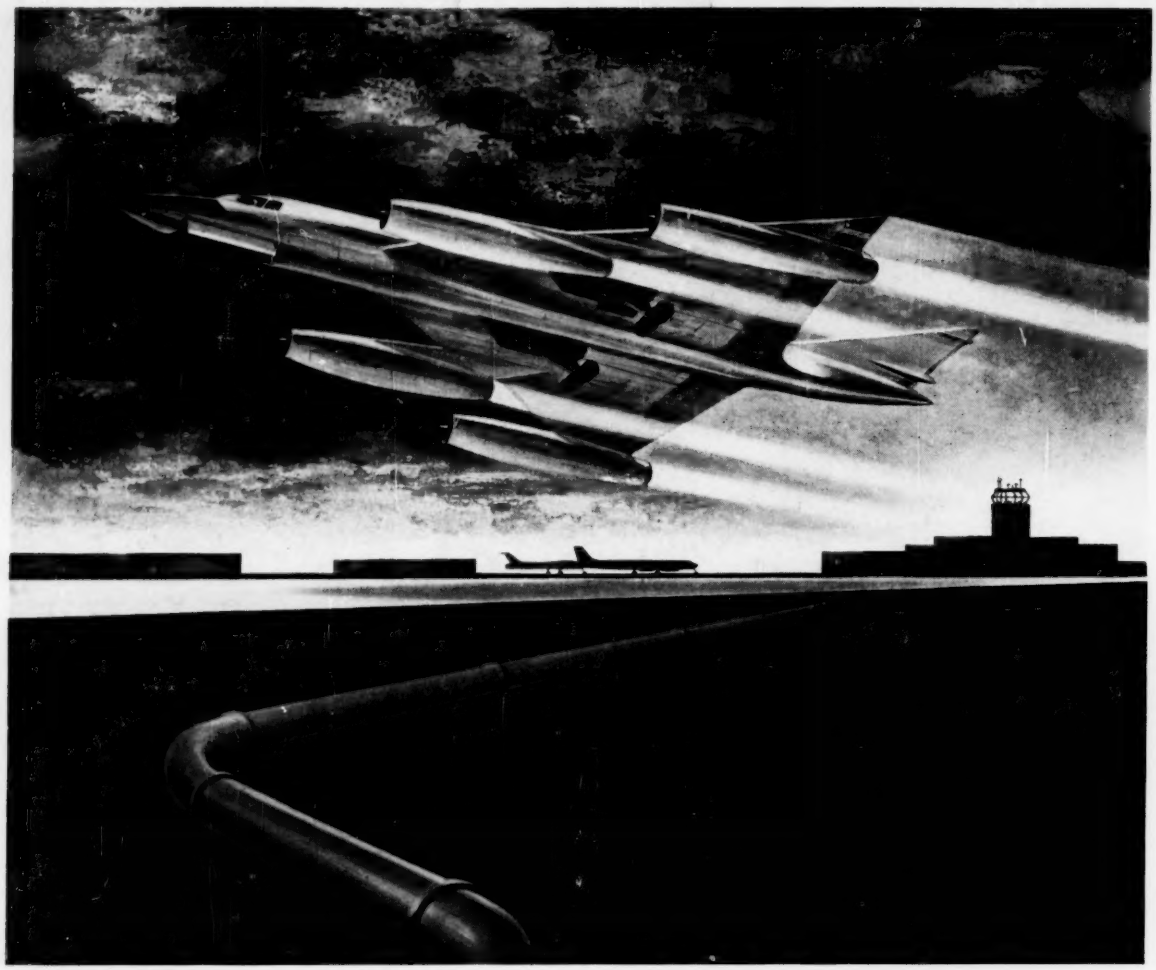

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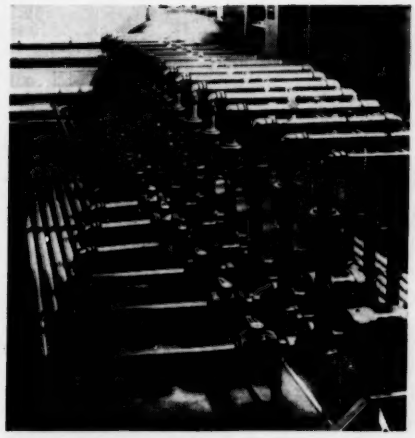
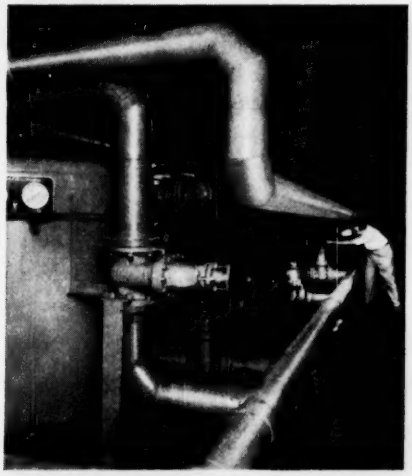


KRALOY PVC Plastic Pipe with plastic valves and fittings installed in the photographic laboratory at the U.S. Air Force Missile Test Center, Patrick AFB, Florida. KRALOY is unaffected by most all common acids.



Swimming pool water filters as installed at one of the leading Miami Beach hotels using 6" KRALOY PVC Plastic Pipe. Note solvent-welded joints to fit all requirements of the installation.

Industry's toughest piping problems are being solved faster, more easily and more economically than ever before by today's great trend to KRALOY Plastic Pipe. Engineers and contractors have found that KRALOY PVC Plastic Pipe meets virtually every piping need and solves corrosion and maintenance problems that no metal pipe or other materials can handle.

Unaffected by electrolysis, highly resistant to salt water scale and most all common acids, KRALOY not only avoids rust-outs and metal deterioration failures—but most important in meeting budget specifications, it is cheaper to install and maintain.

Light in weight (⅛ that of steel), KRALOY's ease of making joints and bending simplifies transportation, handling and laying—*saves up to 50% on installation costs!*

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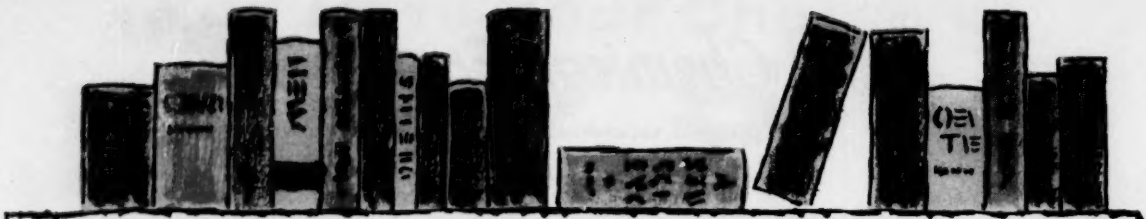

TEXTILE TECHNOLOGY IN CHEMICAL ENGINEERING

Filter fabrics as major filter media

The ultimate effectiveness of any filtration operation depends on how well a filter medium does its job over a given period of time. That is, how efficiently a filtering surface blocks passage of solids while permitting liquid to flow freely, under existing conditions of pressure, temperature, chemical concentration.

Implied in the word "efficiently" are certain requirements related to the physical nature of the medium itself. It must last sufficiently long to make it economical, in terms of both material lost and down-time incurred for scraping, or for replacement or adjustment caused by shrinking and stretching.

No one fabric or group of fabrics can provide the proper medium for all filtration programs. This can be seen in the number of cases which showed, for instance, how a particular filter fabric performed best even though another was at first enthusiastically considered, or how a particular form of yarn had to be used solely because of the gasketing surfaces involved.

Today, with cotton, nylon, dynel, Orlon* and so many other textile fibers available, the filtration engineer has a wider choice of media—and a greater problem in selecting the right one. That is where we come in. The specialists who distribute Wellington Sears filter fabrics will be glad to help in every possible way, calling on both our fabrics and our hundred-some years of experience. For their names, and a handy book of information about filter fabrics, write Dept. L-7

*Du Pont's trademark for its acrylic fiber

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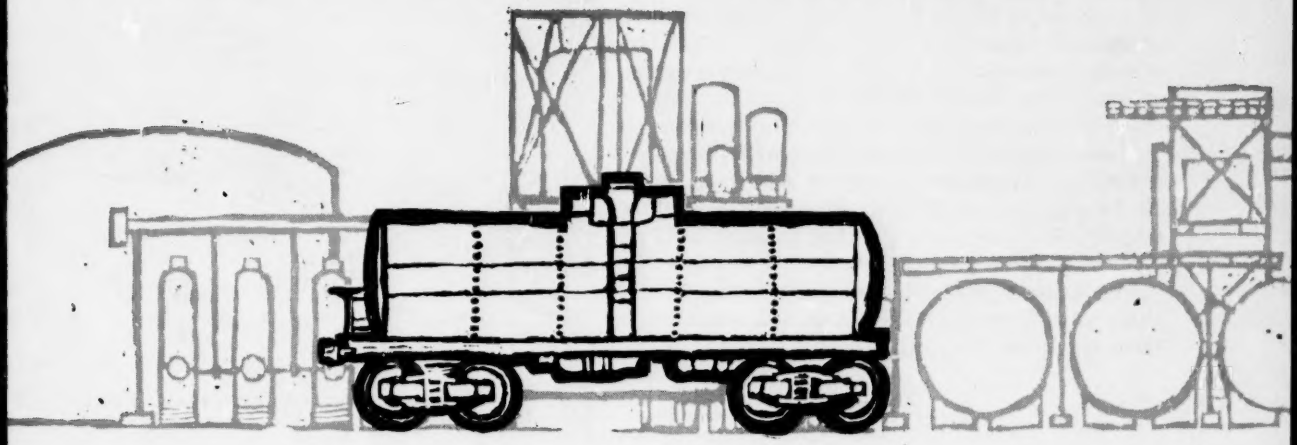
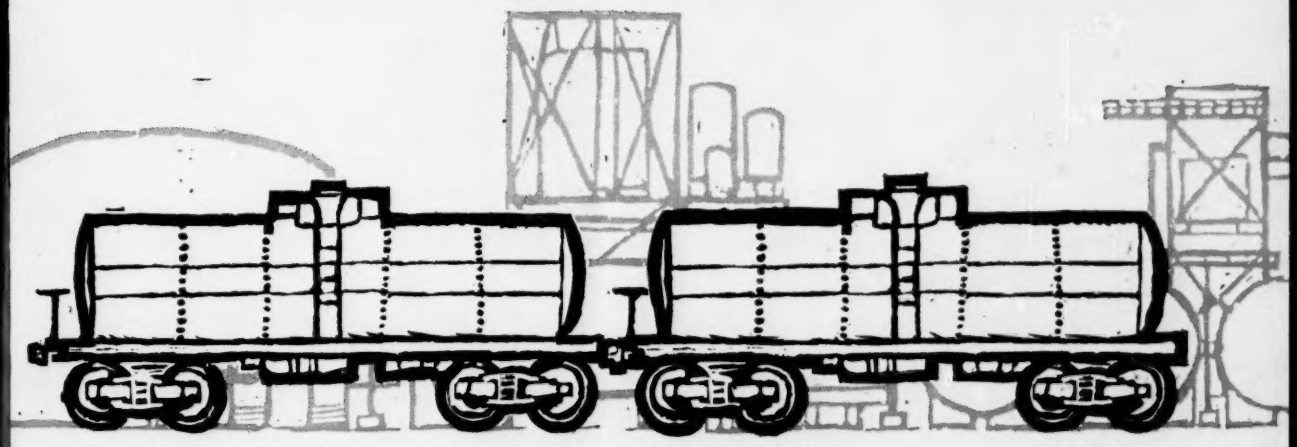


Olin Mathieson did and doubled production



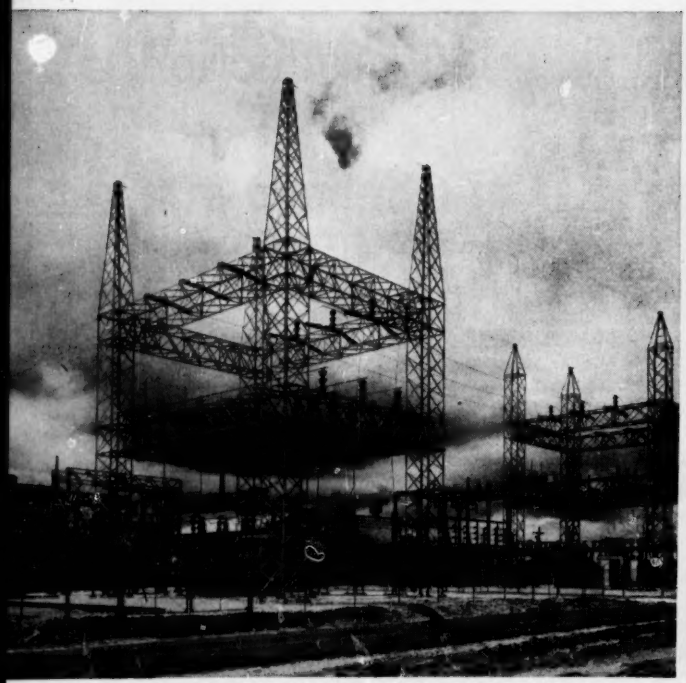
Olin Mathieson doubled production and reduced overhead at their Chlor-Alkali Plant in McIntosh, Alabama. Engineered and constructed by the Blaw-Knox Company, capacity was doubled at a cost of only two-thirds the initial investment.

If you want more capacity to meet the doubled production required by 1965, your Westinghouse representative can help you with a practical solution.

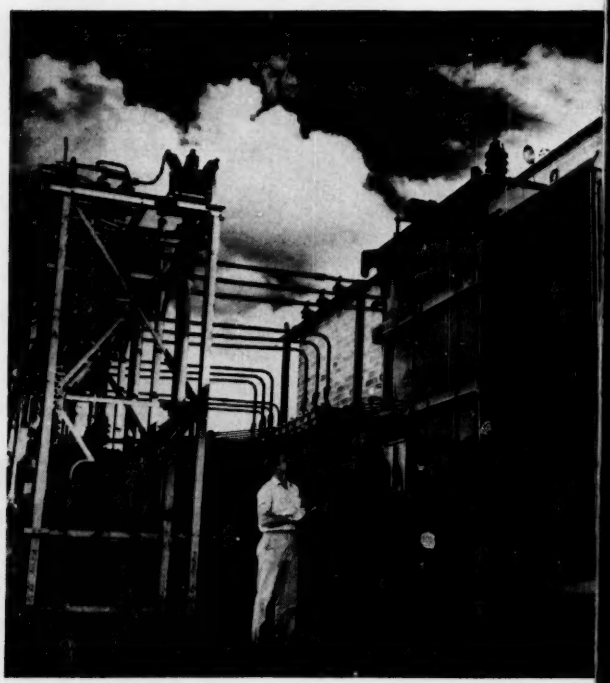
YOU CAN BE **SURE**...IF IT'S **Westinghouse**

here's how Olin Mathieson

Olin Mathieson Chemical Corporation's Chlor-Alkali Plant built by Blaw-Knox Company at McIntosh, Ala.



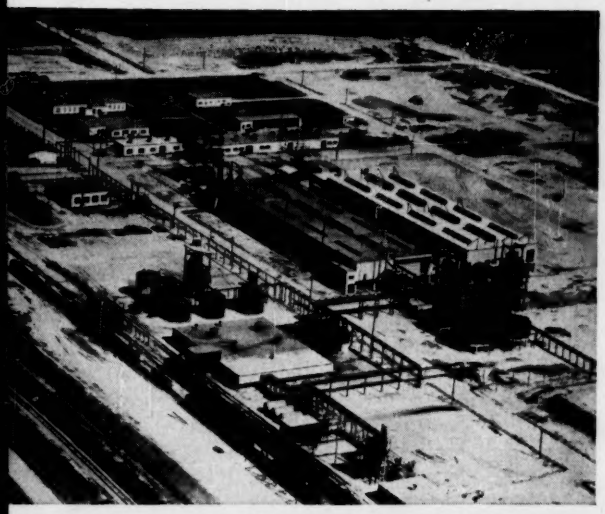
Twin modern substations equipped with Westinghouse metal-clad switchgear provide superior circuit protection. Fast and positive arc interruption is assured.



High mechanical and dielectric strength are two of many plus benefits of the design used in these Westinghouse transformers.

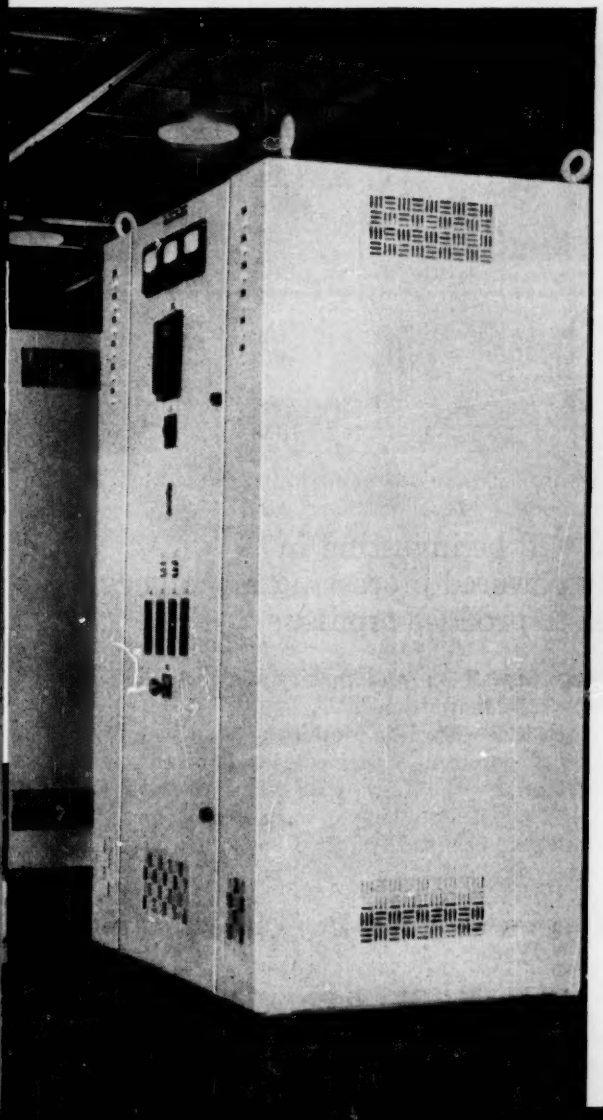
These Westinghouse rectifier auxiliary control cubicles provide smooth, fast variation in output voltage for the exacting demands of electrochemical processing. Here, under constant full capacity load, Westinghouse rectifiers have proved their ability to perform efficiently and with a minimum of maintenance.

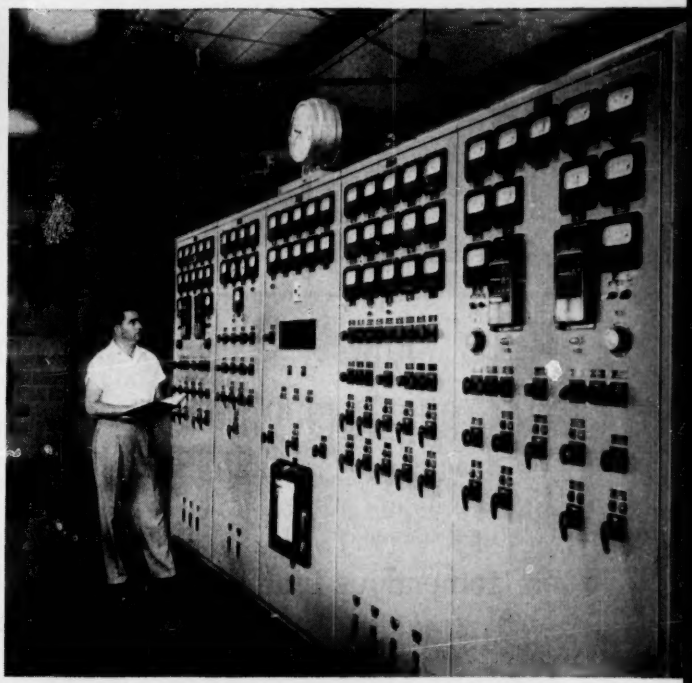
POWERED-UP with Westinghouse



Blaw-Knox, the general contractor, had future expansion in mind when planning started on Olin Mathieson's Chlor-Alkali Plant to be built in McIntosh, Alabama. They determined the electric energy requirements. Then, Westinghouse engineers worked out the most efficient and economical equipment and control to meet these specifications. Westinghouse, Blaw-Knox and Olin Mathieson, working together, decided on certain oversized equipment in anticipation of future needs. This planning paid off. In 1957, capacity was doubled at a cost of $8,000,000 as compared to the initial investment of $12,000,000.

The present daily consumption of electrical energy at this plant is 1,000,000 kilowatthours—equal to the power requirements of a city with a population of 300,000.





This custom designed duplex switchboard installation controls and supervises the electrical circuits. Walk-in cubicle construction makes maintenance easy with equipment protected yet readily accessible. Uniform appearance of all instrument and relay Flexitest* cases gives unit clean, modern appearance.

*Trade-Mark

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here's why you should plan now to

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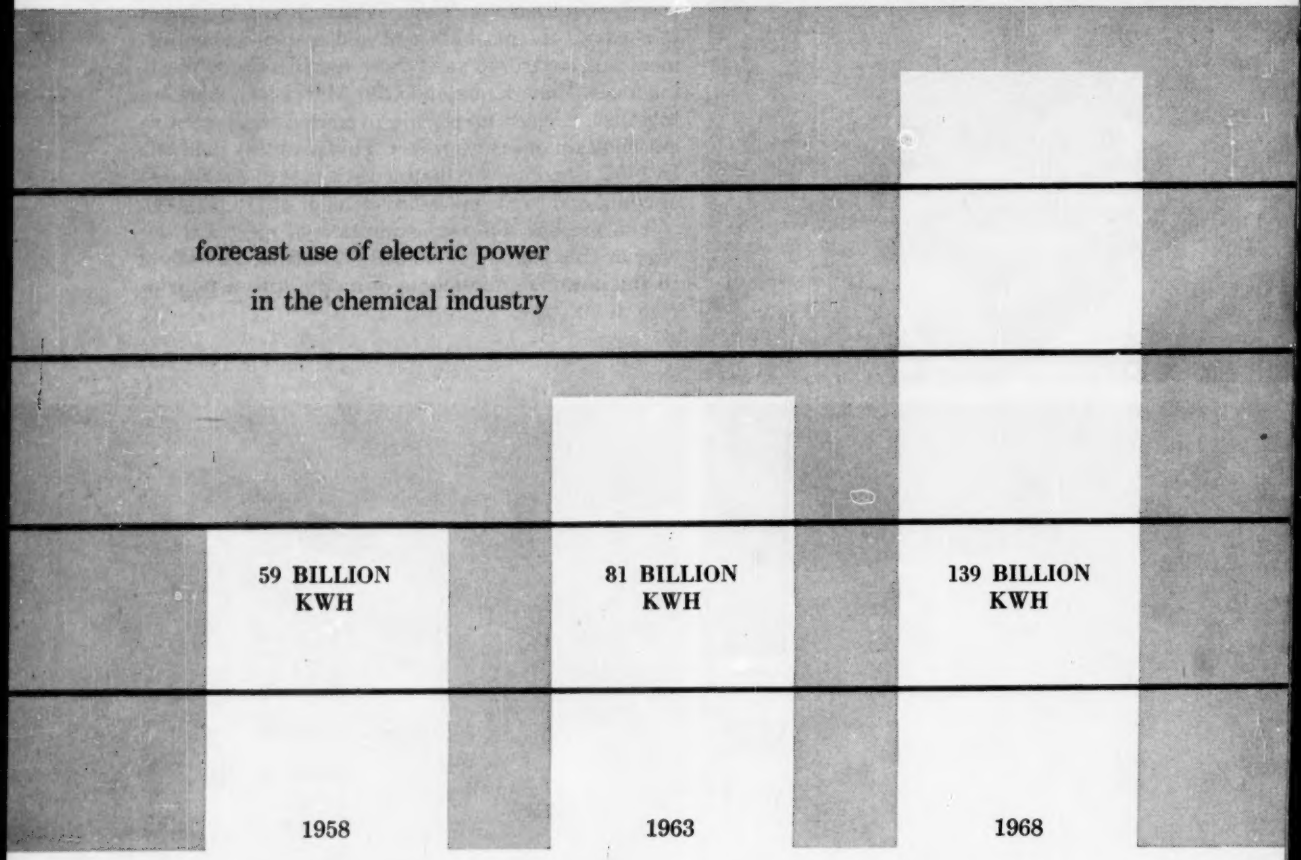

To stay competitive, you will be investing in a tremendous increase in electrically powered processing machinery. Be sure it is engineered to produce profits.

Power-Up is a Westinghouse program to help you increase profits through greater productivity. In your plant it may be a materials handling system, higher capacity machinery, or a more productive environment through higher lighting levels and air conditioning. One thing is certain—whether or not you earn satisfactory profits in the '60s will depend on your making maximum use of low-cost kilowatthours.

Be sure—like Olin Mathieson—that your electrical equipment is engineered to produce profits as well as output. Call your Westinghouse representative. He can tell you the electrical steps you can take *now* to start your Power-Up program.

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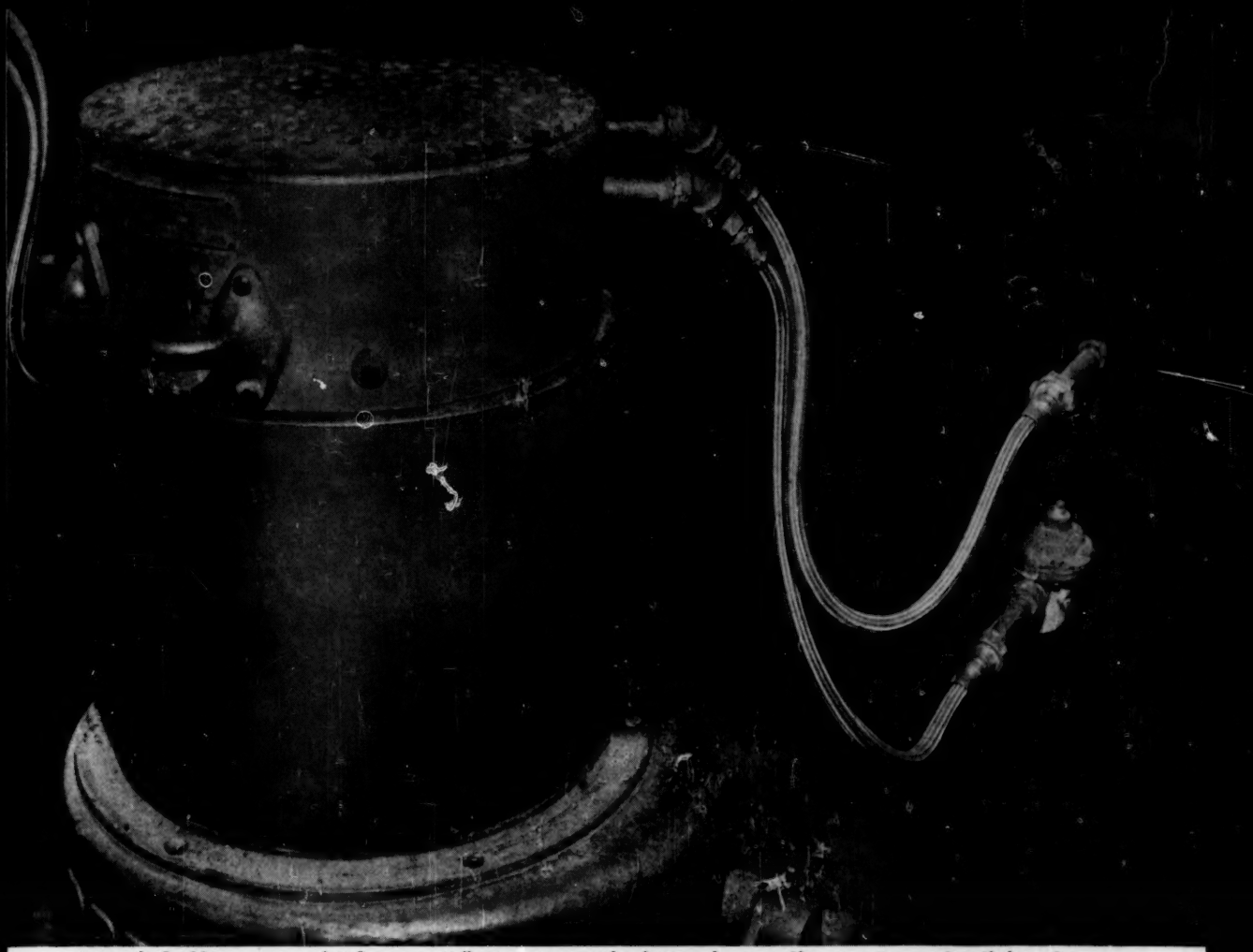

Anaconda flexible connectors of Teflon carry 40-lb. steam to centrifugal steam dryers at Chromium Process Co., Shelton, Conn.

Steam lines formerly lasted 3-4 weeks—but Hose of Teflon* by Anaconda passes 13 months, still going strong

It's a little over a year that these flexible connectors of Teflon by Anaconda have been serving The Chromium Process Company. During this period, 12 sets of rubber hose would have been required. Add to this the cost of down time and labor for replacement.

This is just another example of how flexible connectors of Teflon by Anaconda are saving time and money in tough jobs. Anaconda offers a line of standard hose assemblies and engineering services for design and development of connectors to meet special applications. Send coupon below for catalog. For technical assistance write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut.

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*DuPont trademark for TFE-fluorocarbon resin.

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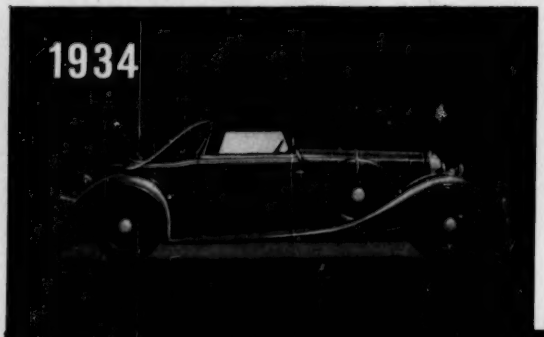

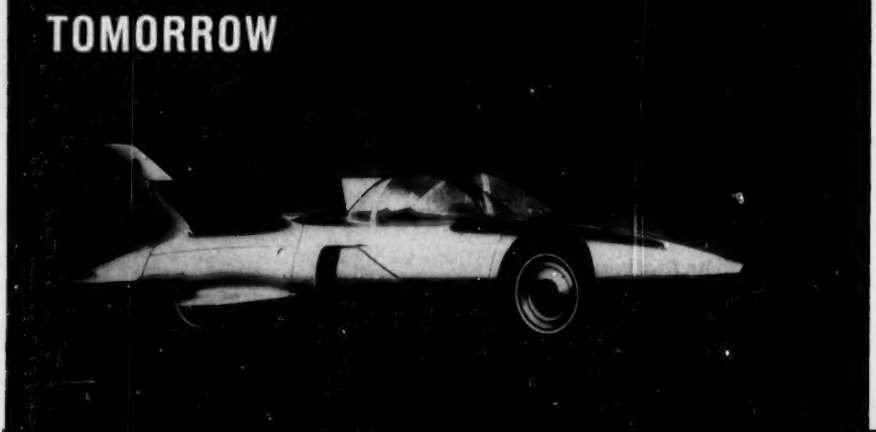

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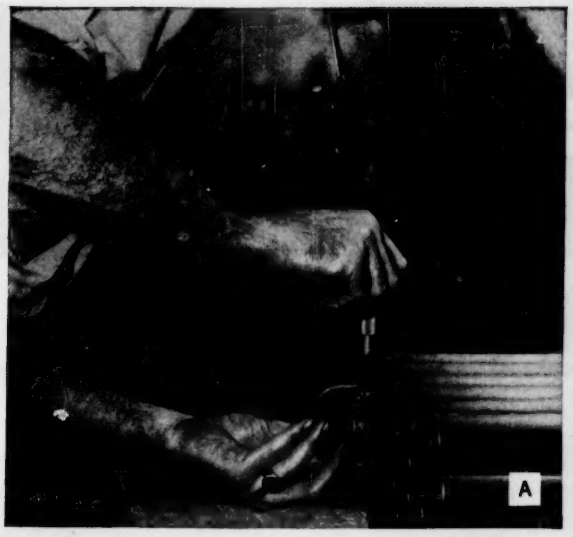

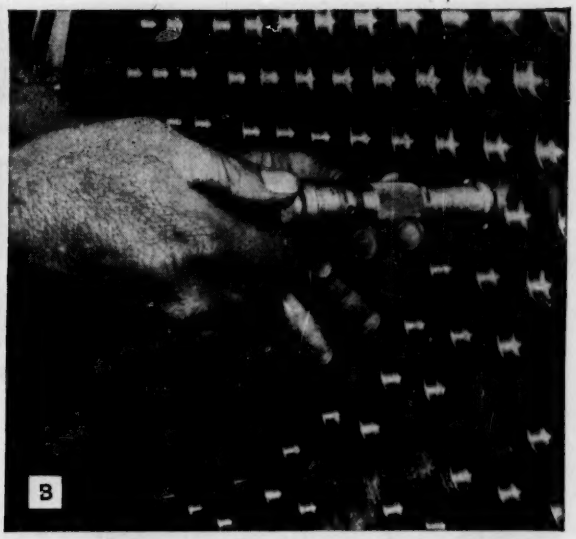

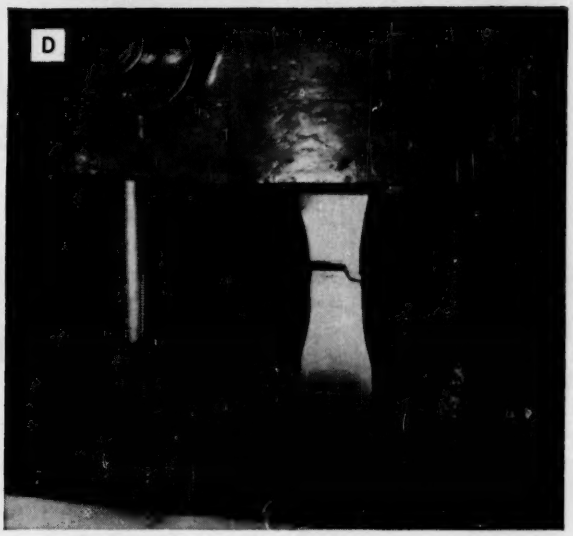

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C **In the dark**—but not for long. Our own darkroom permits immediate developing of X-ray films...gives our inspector a fast check of weld structure and soundness.

D **Reply requested**—Our inspectors get many prompt reports from our own testing lab. Here's a tensile test on our own machine. It helps speed testing and inspection.

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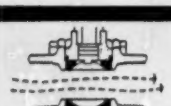
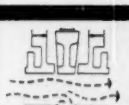
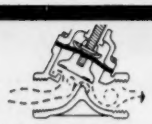
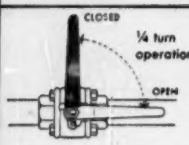
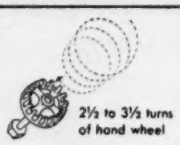
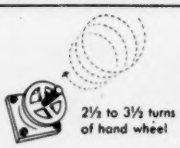
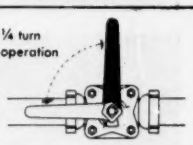
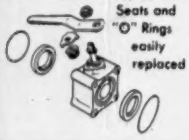
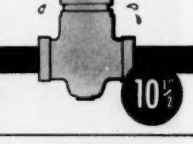
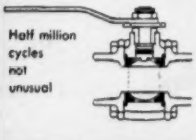
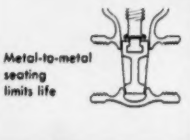
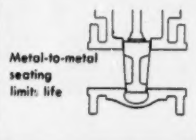
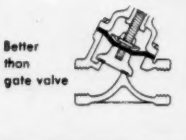
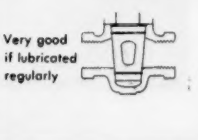
HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

DOWNINGTOWN IRON WORKS Hackney

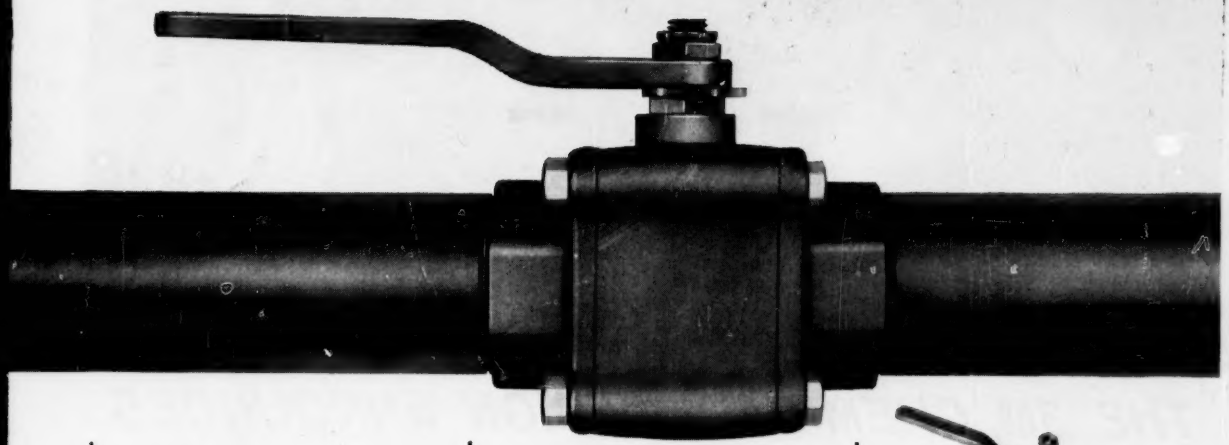
COMPARE...

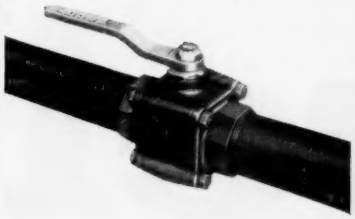
ECON-O-MISER	GATE VALVE	FLANGED GATE VALVE	DIAPHRAGM VALVE	LUBRICATED PLUG VALVE
 Smooth round flow	Turbulence results in excessive pressure drop	 Turbulence results in excessive pressure drop	 Turbulence results in unusually high pressure drop	Constricted flow... pressure drop
 CLOSED ¼ turn operation OPEN	 2½ to 3½ turns of hand wheel	2½ to 7 turns of hand wheel	 2½ to 3½ turns of hand wheel	 ¼ turn operation
 Seats and "O" Rings easily replaced	Valve normally thrown away	30% to 50% of purchase price	In-line maintenance possible	Regular lubrication necessary to maintain seal
CENTER TO TOP—OPEN 3 5/16	12 5/8	16 1/2	7 1/4	 10 1/2
 Half million cycles not unusual	 Metal-to-metal seating limits life	 Metal-to-metal seating limits life	 Better than gate valve	 Very good if lubricated regularly

ECON-O-MISER BALL VALVE

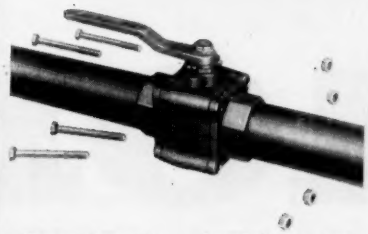
MORE EFFICIENT . . . LESS COSTLY

THE ECON-O-MISER BALL VALVE





Compact, efficient ECON-O-MISER Ball Valves are today's smoothest operating on-off valves. A quarter turn of the handle allows full operation and you can tell at a glance whether the valve is open or closed. More . . . ECON-O-MISER Ball Valves act as both valve and union . . . eliminate costly inventory and labor. Minimum turbulence and greater economy make this valve ideal for hundreds of applications.



Remove four nuts . . . four bolts . . . and the entire center section lifts out for servicing. Quick, convenient maintenance saves money **and** this unique design means pipe ends never have to be removed from the line. Seating surfaces and O-Rings are easily replaced . . . whole valve back in operation in minutes. Reduces inventory expenses and frees maintenance personnel from time consuming repairs.

The ECON-O-MISER Ball Valve is available in many combinations of seats, O-Rings and body materials. Almost any media can be handled by the ECON-O-MISER and sizes range from ¼" through 6". Made of bronze, aluminum, carbon steel, stainless steel or aluminum bronze. We'll be happy to furnish information or application data.

THE ONLY VALVE IN INDUSTRY THAT SERVES AS BOTH VALVE AND UNION!

Complete, technical information in new "Comparison" bulletin.

Request EB 101 on your letterhead or fill in coupon.

NAME _____ TITLE _____

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ADDRESS _____

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☐ Please forward bulletin EB 101. ☐ Please ask sales engineer to call for appointment. ☐ Send information on ECON-O-MISER FLANGE BALL VALVE.

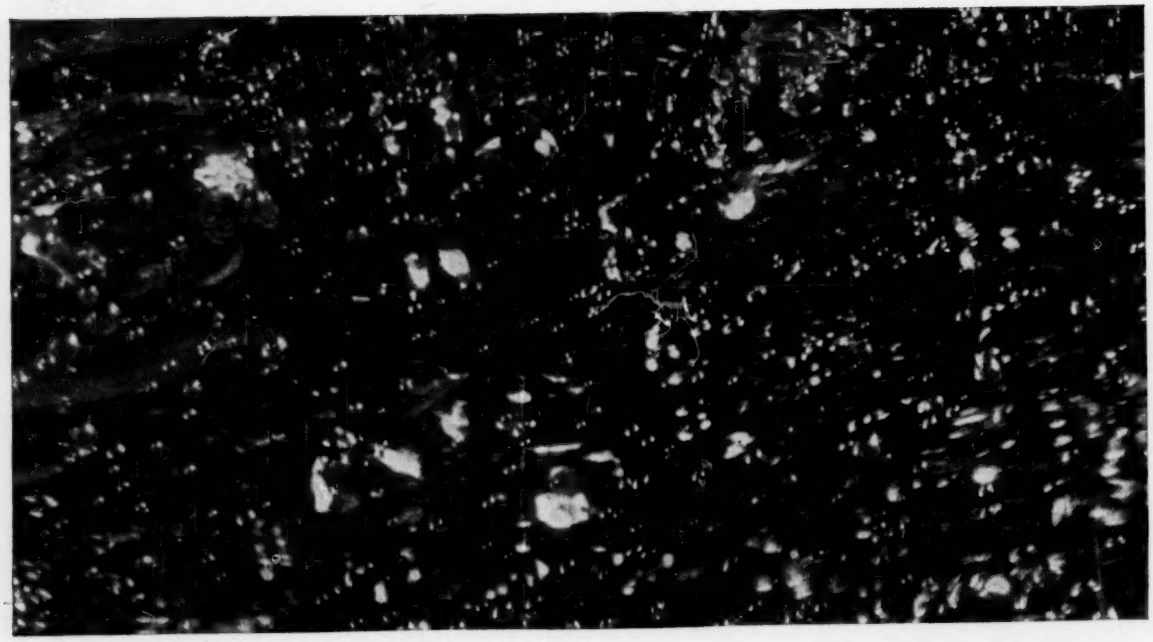
WORCESTER VALVE CO., INC.

DEPT. A • 16 PARKER STREET • WORCESTER, MASS.

THE 3M CHEMICAL DIVISION ANNOUNCES

fluorel*

BRAND ELASTOMER



3M COMPANY CHEMICALS

THE RAW MATERIALS OF PROGRESS

New fluorinated synthetic rubber offers top performance in contact with oils, fuels, solvents, acids at temperatures over 400°F. and under some service conditions at temperatures up to 600°F. And it's particularly easy to process and mold.

Even at extreme temperatures, FLUOREL Elastomer maintains excellent resistance to compression set. Approaching 600°F, elongation and hardness do undergo a slight change. Yet, no matter how hot it gets, FLUOREL Elastomer will never support combustion.

On the other end of the temperature scale, at −50°F. thin sections may be bent.

As well as being highly resistant to corrosive fumes and many fluids even when they're blistering hot, FLUOREL Elastomer shows no change after one year's exposure in a heavy industrial atmosphere. Ozone resistance? No cracking after 200 hours' exposure at 150 ppm by the bent loop method.

FLUOREL Elastomer exhibits electrical properties comparable to those of electrical grade vinyl chloride polymers. That's indicative of good performance, but specific data is yours for the asking.

To complete the property picture: FLUOREL Elastomer is moderately resistant to gamma radiation emitted by Cobalt 60.

EASY TO PROCESS—Besides being easy to process on conventional equipment, FLUOREL Elastomer is easy to compression mold and extrude, and it can be bonded to most metals with adhesives.

No doubt about it! FLUOREL Elastomer is an important newcomer to the ever-expanding family of 3M organic fluorine compounds. It's the direct result of the same pioneering know-how and research that have made 3M a leader in the chemical industry. Following the tradition of its many predecessors, FLUOREL Elastomer should greatly extend the performance range of applications requiring elastomeric materials.

APPLICATIONS—FLUOREL Elastomer is now either in use or under evaluation in the missiles and aircraft, automotive and chemical processing industries for oil seals, "O" rings and gaskets. Tests and field reports are encouraging and suggest other applications as yet untried, such as fire walls, air ducts, fuel cells, fuel and hydraulic hose, diaphragms and tank linings.

For complete data, at our expense, write: 3M, Chemical Division, Dept. KAL-79, St. Paul 6, Minnesota.

**The term FLUOREL is a trademark of Minnesota Mining and Manufacturing Company.*

CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

...WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

THE INDUSTRIAL TRACTOR SHOVEL THAT

COMPARE

COMPARE YALE FOR POWER, ACTION, SAFETY, DESIGN.

Industrial plants from coast to coast—in Canada and Latin America—have accepted the Yale Industrial Tractor Shovel as the pacesetter of the field. Compare Yale's exclusive features and you'll understand why.

POWER

ONLY YALE GIVES YOU MATCHED TORQUE TRANSMISSION!

72-hp. 6-cylinder engine provides smooth power through matched torque converter and Yale torque transmission (fully automatic). One-speed range forward—one-speed range back. Inching control for delicate close-quarter maneuvering. Extra punch for impact loading. Accelerates to 13 mph. in 5½ seconds.

ACTION

ONLY YALE GIVES YOU A PERFORMANCE COMBINATION LIKE THIS!

2500-lb. carry capacity. Exclusive 45° bucket tipback permits faster loading and lowest carry position for faster transport with minimum spillage. 6' dumping clearance for dumping into bins and hoppers out of range of other—even larger—tractor shovels. Shortest turning radius—only 73".

SAFETY

ONLY YALE GIVES YOU BOTH THESE IMPORTANT SAFETY FEATURES!

Safety-curve lifting mechanism members never rise alongside the operator. Front and rear working lights give additional security.

DESIGN

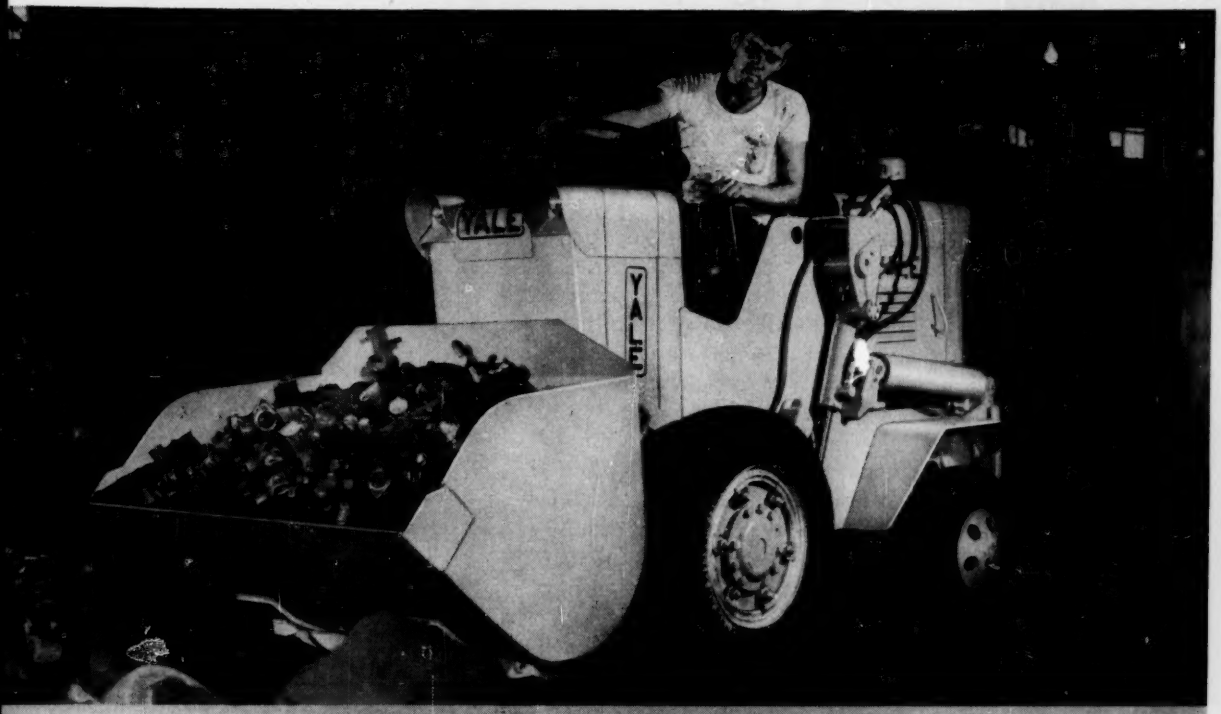
ONLY YALE GIVES YOU THIS COMBINATION OF DESIGN FEATURES!

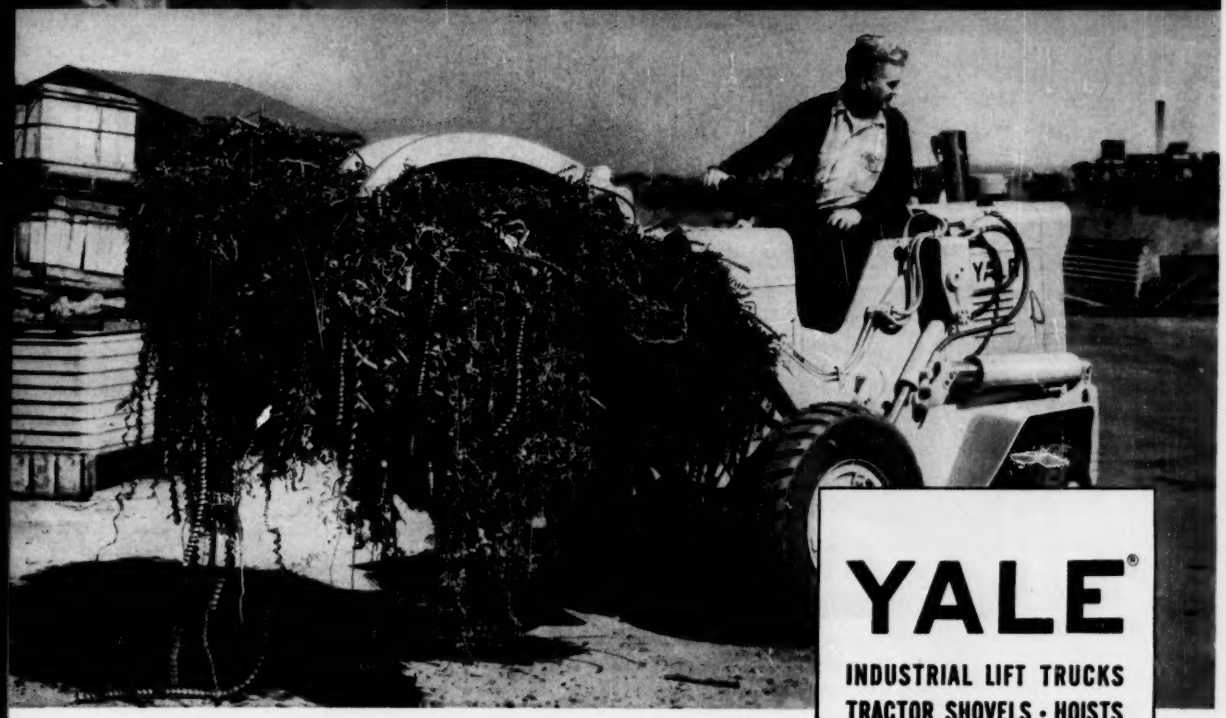
Rugged, simplified design! Sealed brakes and electrical system! Protected steering linkage! 10-ply tires! Whatever the job requirement—all these features add up to a more efficient performance at less cost—25% more work per hour. Full range of buckets and attachments available.

Leading companies throughout the country are productively using the Yale Industrial Tractor Shovel. Names on request.

For a demonstration in your plant or full data, contact your Yale representative. Or write The Yale & Towne Manufacturing Company, Yale Materials Handling Division, Philadelphia 15, Pennsylvania, Dept. YT-3V.

SETS NEW PERFORMANCE STANDARDS FOR INDUSTRY





YALE®

INDUSTRIAL LIFT TRUCKS
TRACTOR SHOVELS • HOISTS

YALE & TOWNE

Yale Materials Handling Division, a Division of The Yale & Towne Manufacturing Company.
Manufacturing Plants: Philadelphia, Pa., San Leandro, California, Forrest City, Arkansas.
Products: Gasoline, Electric, Diesel and LP-Gas Industrial Lift Trucks • Worksavers Warehousers • Hand Trucks • Industrial Tractor Shovels • Hand, Air and Electric Hoists

How lasting quality is
Heat Exchanger

Fabrication of Phelps Dodge heat exchanger and condenser tubes starts with the casting of billets. In this process, high grade copper (over 99.90% pure) from Phelps Dodge's own mines is alloyed with the finest quality metals available. The alloys are melted in electric furnaces and cast in specially designed water-cooled molds that produce sound, homogeneous billets.

Each billet must conform to rigid Phelps Dodge standards, as well as to the requirements of ASTM and U.S. Government specifications. Strict control is maintained over every phase of the billet-casting operation.

Before melting, the metals to be alloyed are carefully weighed to their correct proportions in the cast billet. Each melt is carefully sampled for chemical and spectrographic analyses which verify the composition of the billet before it is released for further processing.

Throughout the entire tube fabrication—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.

1

BILLET-CASTING

(FIRST OF A FIVE-PART SERIES)

Casting shop area in new Phelps Dodge tube mill at South Brunswick, N. J. This mill has the largest copper and copper-alloy tube capacity in the U. S.

Alloy proportions are carefully checked by spectrographic analysis to assure conformance with exact specifications.

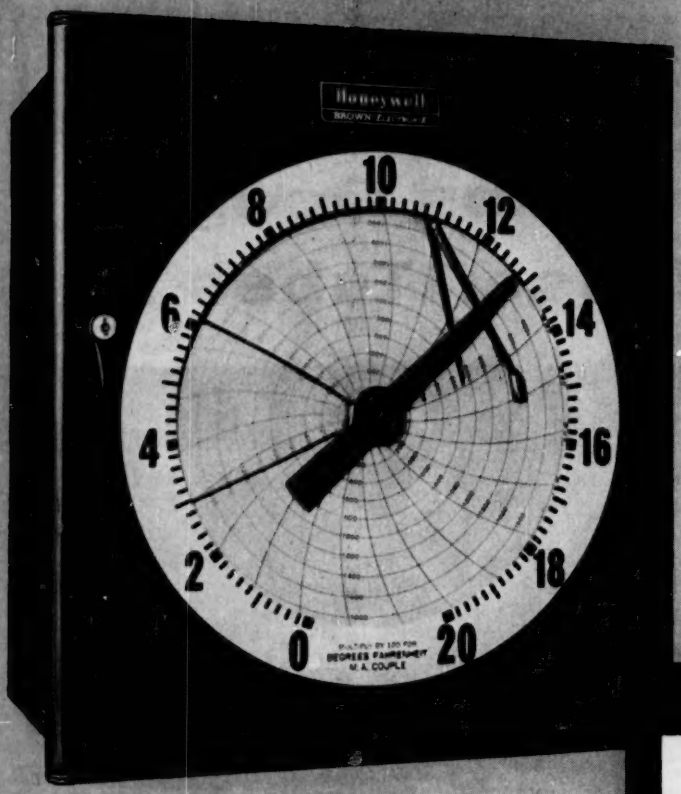
built into Phelps Dodge and Condenser Tubes...

Close-up of casting operation shows molten metal flowing from electric furnace into specially designed molds.

PHELPS DODGE COPPER PRODUCTS CORPORATION

First for Lasting Quality—from Mine to Market!

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.


Honeywell
BROWN ELECTRONIK
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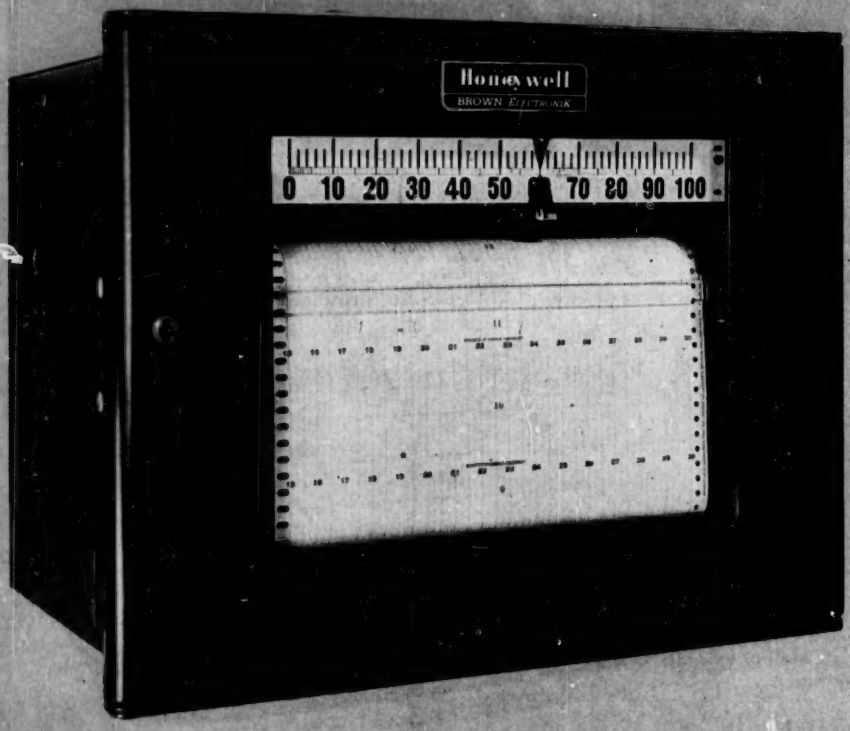
NOW!


Honeywell
BROWN ELECTRONIK
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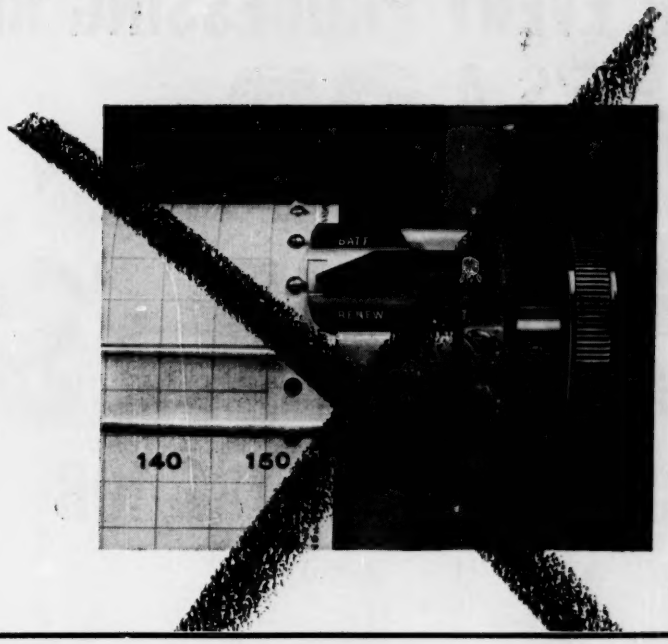


NO BATTERIES OR STANDARD CELLS

in *ElectroniK* potentiometers

The new Honeywell Continuous Voltage Stabilizer makes batteries, standard cells, and standardizing mechanisms unnecessary in new Brown *ElectroniK* circular or strip chart potentiometers. This new unit accurately regulates the D-C reference voltage supply to the measuring circuit. Standardization is no longer necessary.

The small, compact stabilizer unit uses Zener diodes and an ambient temperature compensator to deliver a constant rectified voltage from line supply. This assures uninterrupted response to changes in the measured variable.

The Continuous Voltage Stabilizer means more dependability, less maintenance, continuous attention to the measured variable, and still another reason why *ElectroniK* instruments are your best value in measurement and control. Get full details from your nearby Honeywell field engineer . . . he's as near as your phone.

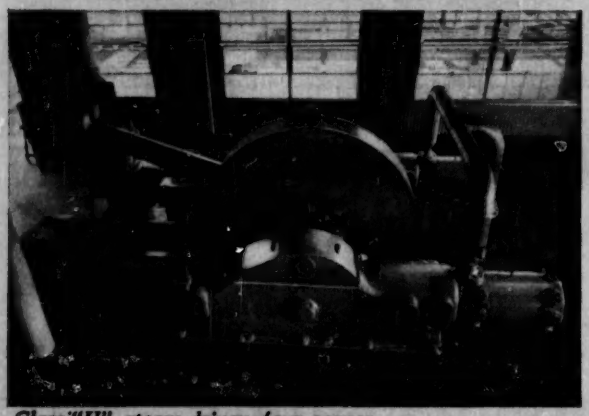
MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

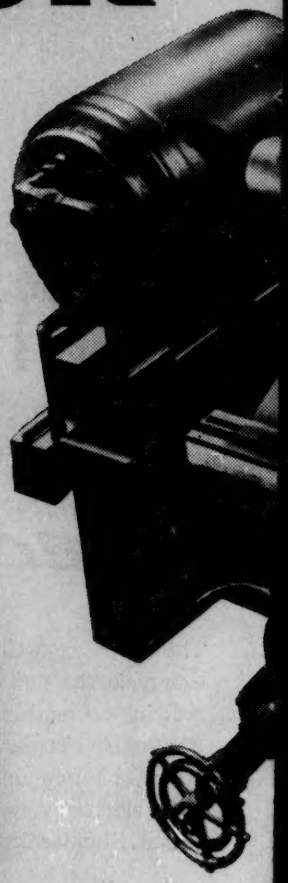
H HONEYWELL

First in Control

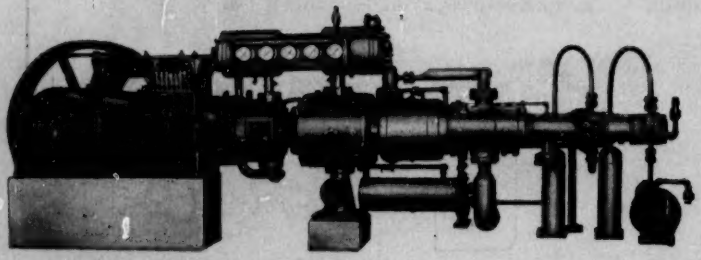
FOR EVERY PROCESSING REQUIREMENT THERE'S A CP COMPRESSOR MADE JUST FOR THE JOB



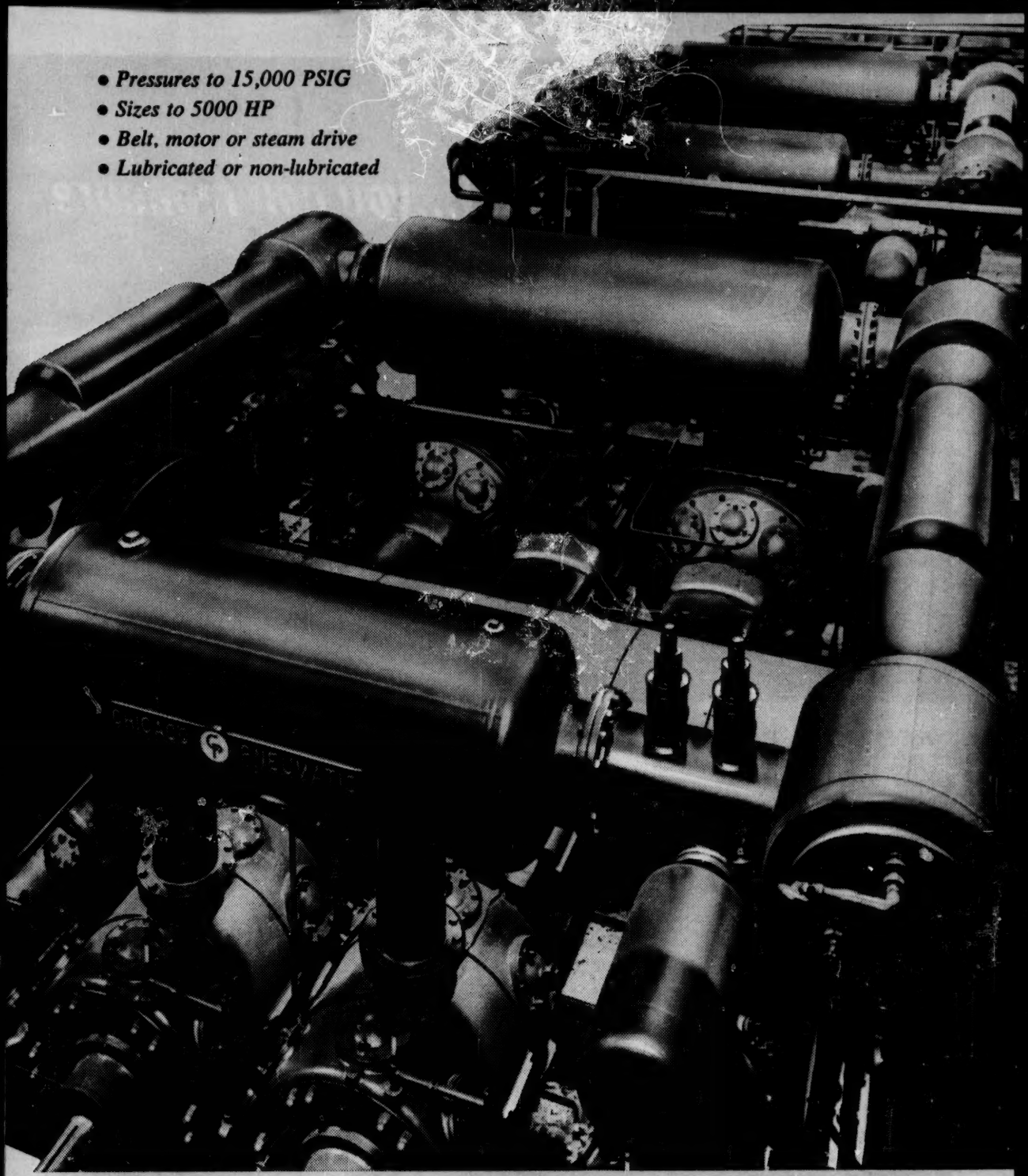
Class "H", steam-driven, four-corner, single-stage hydrocarbon gas booster.



Class "Y" butane compressor, coupled to an explosion-proof motor. In service in a large refinery.



Class "T", horizontal, straight-line, five-stage helium compressor. 6000 psig; 100 hp size.

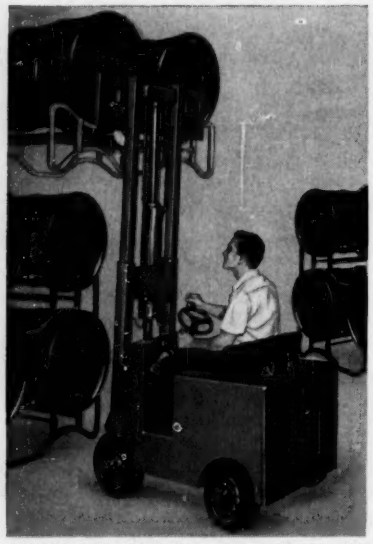


Two Class "FE" balanced-opposed compressors in process work. 3500 hp; five-stage.

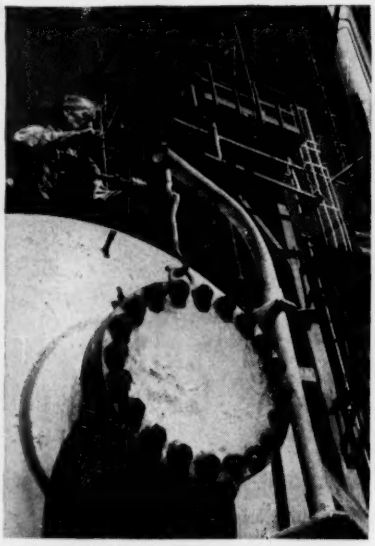
Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

REPUBLIC PRODUCTS SERVE THE PROCESSING INDUSTRIES



STACK, STORE, PROTECT your products with Republic Steel Containers and Drums. Strong, safe, Republic Steel Containers and Drums are available in a wide range of types, sizes, and finishes to meet virtually every need. Call your Republic representative, or write today.



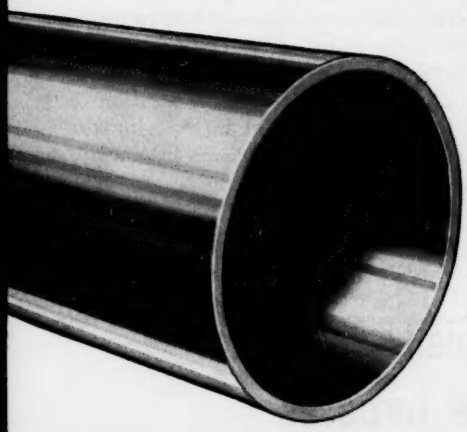
REPUBLIC ALLOY STEEL STUDS AND HIGH CARBON HEX NUTS resist high temperatures, high pressures, corrosion. . . . three common causes of stud failure. Clean, accurate threads provide maximum holding power, resistance to wear. Specify Republic on your next order.

ELIMINATE CORROSION PROBLEMS in a wide variety of oil and natural gas handling applications with Republic Plastic Pipe. Republic produces a complete range of sizes in SRK (A.B.S. Material), SRB (Semi-Rigid Butyrate). Easy to use. Send coupon.

FARROWTESTED TUBES ARE YOUR BEST BUY !

... exclusive with Republic ***ELECTRUNITE*** *Heat Exchanger Tubing*

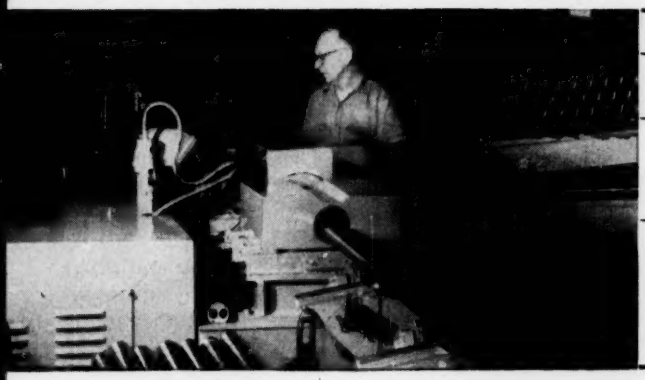
... Carbon and Stainless Steel. FARROWTESTED tubes have passed the most searching test of all, a non-destructive eddy-current test that probes for and detects injurious defects. On a production basis, the magic eye of FARROWTEST looks deep within the tube wall, is calibrated to reject tube with defects as shown in the table below. Defects that pass internal fluid or gas pressure tests, which cause a premature failure.



FARROWTEST® is offered as an alternate to other less positive tests at no increase in cost! Carbon steels produced to ASTM specification A-214; stainless steels to A-249. Both include eddy-current test requirements.

As a tube buyer and user, you owe it to yourself and your company to get the facts firsthand. ELECTRUNITE® Heat Exchanger Tubes are being production tested on FARROWTEST equipment every day. It is there for you to see. Additionally, Republic has performed "autopsies" on all types of tube which FARROWTEST has rejected. The hidden defects are there for you to inspect at our Cleveland mill.

Specify FARROWTESTED Republic ELECTRUNITE Heat Exchanger Tubes and get *quality you can measure.* Call Republic or send coupon.



FARROWTEST REJECT TABLE

Wall Thickness (B.W. Gage)	Minor dimension of the defect (Length or Depth)	Defective Area (Length X Depth Plane)
20	.006"	.0025 sq. inches
18	.006"	.003 sq. inches
16	12½% of wall	.003 sq. inches
14 and 13	12½% of wall	.004 sq. inches
12 and heavier	12½% of wall	.005 sq. inches

FARROWTEST detects and rejects not only tubing containing defects which completely penetrate the wall; but also tubing with defects equal to, or greater than, those shown in this table. For irregular defect shapes, a tube with defect area equal to or greater than shown above is rejectable. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
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Please send additional information on the following:

☐ Republic ELECTRUNITE Heat Exchanger Tubing
☐ Republic Steel Drums ☐ Containers
☐ Republic Alloy Studs, High Carbon Hex Nuts
☐ Republic Plastic Pipe ☐ FARROWTEST

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Harbison-Walker Specialized Refractories withstand severe conditions . . .

Longest service and lowest maintenance costs largely depend upon the best selection and use of refractories. The schematic drawing here shown, illustrates typical brand selections for severe conditions in various sodium silicate furnaces. The brands indicated for each location possess the chemical and physical properties needed for longest service for that particular position. Other Harbison-Walker brands provide alternate selections for less severe conditions.

Harbison-Walker produces all the different kinds of refractories needed to most closely equalize each other in service. Their proper selection and use assures longest campaigns, and minimum overall costs, in furnaces producing various classes and composition ratios of alkali to silica.

Your experience and comprehensive knowledge of your operating conditions, and the availability of these quality-controlled refractories of known properties and performance records, affords the means of selection for the best results.

Harbison-Walker freely offers the cooperation of the Technical Service Department in choosing the refractories for greatest economy in each specific application.

Some HARBISON-WALKER BRANDS especially suited for the rigorous conditions of sodium silicate furnaces

[redacted] is the magnesium silicate checker brick which continues making splendid records. Also included in the category of basic refractories for use in regenerators are several periclase compositions having bonds of forsterite, magnesium-aluminate and duo-spinels.

[redacted] used for many years in crowns, is regarded as standard at many plants.

[redacted] serves with excellent results in the upper side walls and crowns of metasilicate furnaces.

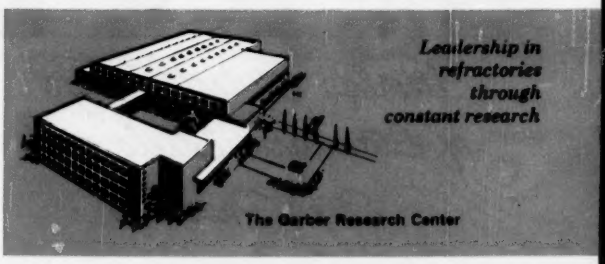
[redacted] consists of corundum bonded with mullite and has a total alumina content of 90%. It is used with benefit, surpassing many other refra tories, in port necks and paving, jambs and sills and around tapping holes.

[redacted] are special dense, extra hard-fired, super-duty fireclay brick, fully stabilized in their alumina content to mullite, with residual cristobalite. It is exceedingly low in porosity and permeability. Its properties commend it for complete side walls of furnaces producing ortho-sodium silicates.

[redacted] Among the complete range of refractories widely used in this industry are Harbison-Walker brands of high duty fireclay brick and super-duty fireclay brick. These may be furnished from any one of many locations, thus facilitating delivery time, and reducing transportation costs.

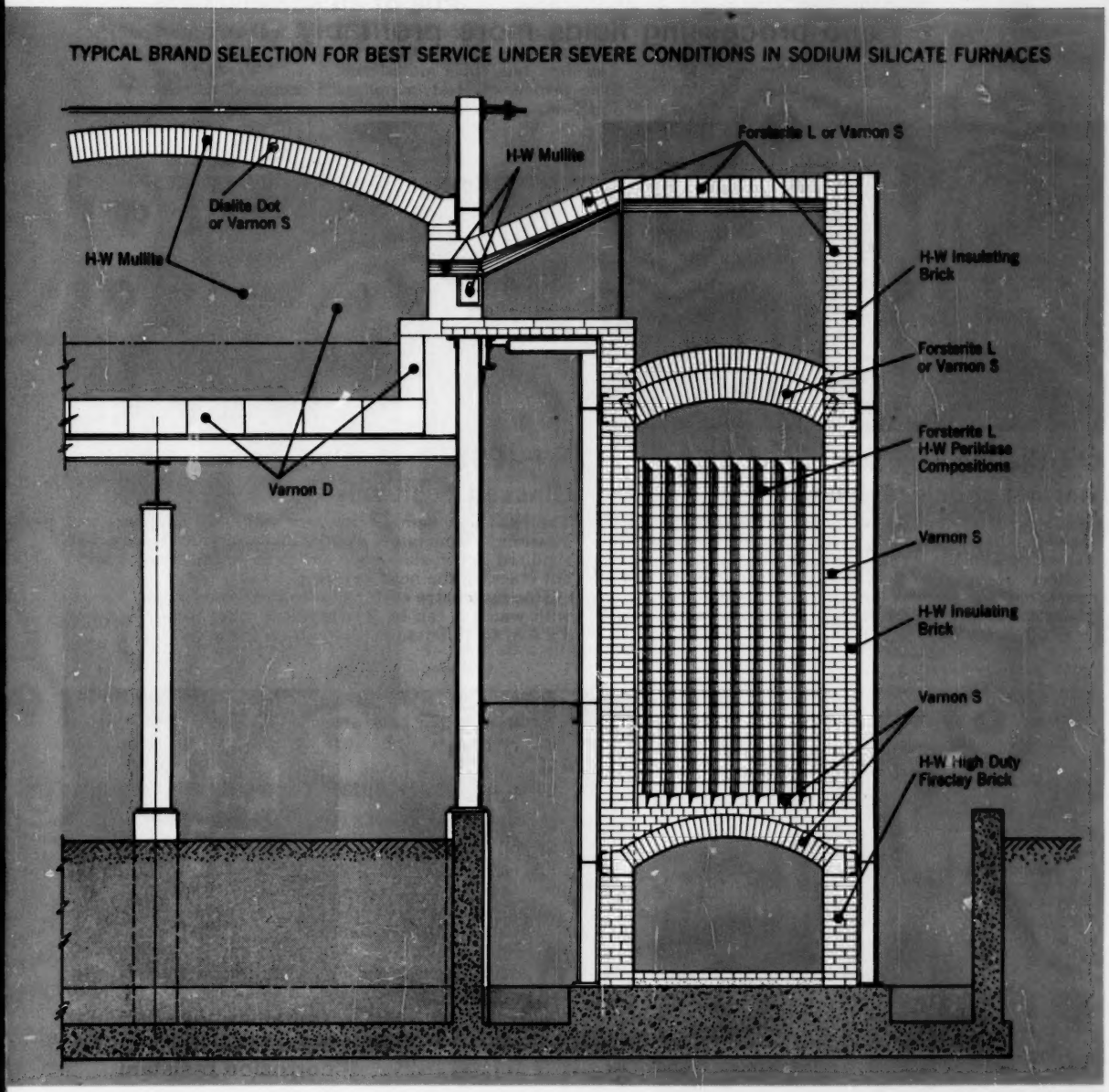
Harbison-Walker insulating fire brick and other insulating materials of all classes serve advantageously in various applications of sodium silicate furnaces.

Harbison-Walker makes the complete range of castable refractories, a number of which are in reality specialized for use in certain parts of sodium silicate and glass furnaces. They provide a selection of materials as serviceable as prefired refractories, for monolithic constructions of a difficult or complex design.



for SODIUM SILICATE FURNACES

assure longest service and lowest cost


TYPICAL BRAND SELECTION FOR BEST SERVICE UNDER SEVERE CONDITIONS IN SODIUM SILICATE FURNACES
H-W Mullite
Dialite Dot or Varnon S
H-W Mullite
Varnon D
H-W Insulating Brick
Forsterite L or Varnon S
Forsterite L H-W Periklase Compositions
Varnon S
H-W Insulating Brick
Varnon S
H-W High Duty Fireclay Brick

Harbison-Walker Refractories Company

AND SUBSIDIARIES
GENERAL OFFICES: PITTSBURGH 22, PENNA.

World's Most Complete Refractories Service

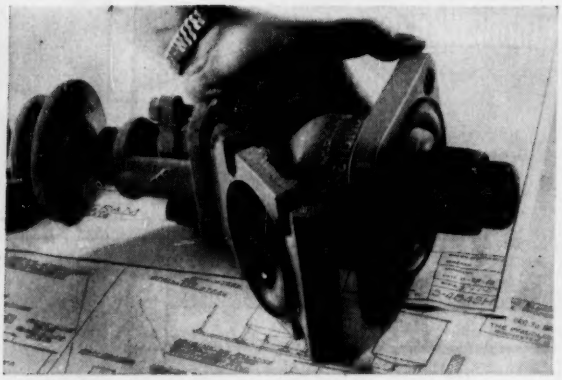
FLUIDICS AT WORK

...developing new products and materials of construction for handling and processing fluids more profitably

Glasteel 59 with 30% more thermal shock resistance

This laboratory test shows iced water hitting 450°F. Glasteel 59. No thermal shock damage resulted. Our process equipment carries a safety factor of three, so Glasteel 59 now gives 150°F. thermal shock protection at a peak operating vessel temperature of 450°F.

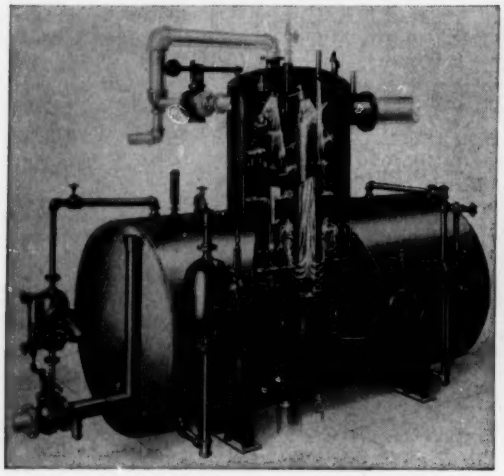
Glasteel 59 also offers excellent acid and alkali resistance. (Bulletin No. 980)



Glassed flush valve

The head and stem on this new valve are *one piece and glassed* . . . eliminating a major cause of valve failure. The rigidized Teflon-glass fiber seat permits firm seating without cracking the head covering.

This glass valve costs no more than conventional valves, with which it can be interchanged. Sizes from 1½ x 1 to 8 x 6 in six different models. (Data Sheet No. 42)

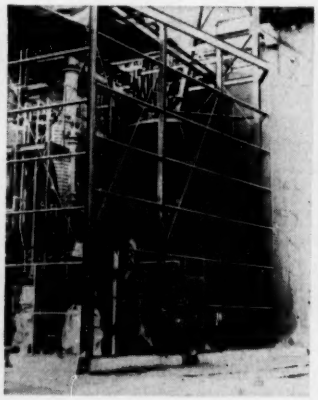


Deaerator that scrubs water to 0.005 ml/l of oxygen

You can process 150,000 lbs/hr of water through this Permutit Type B deaerator and reduce oxygen almost completely.

Type A deaerator handles up to 3,000,000 lbs/hr.

Both are available in either horizontal or vertical designs. (Bulletin No. 2357)



Glasteel chlorine dioxide generators resist all corrosives

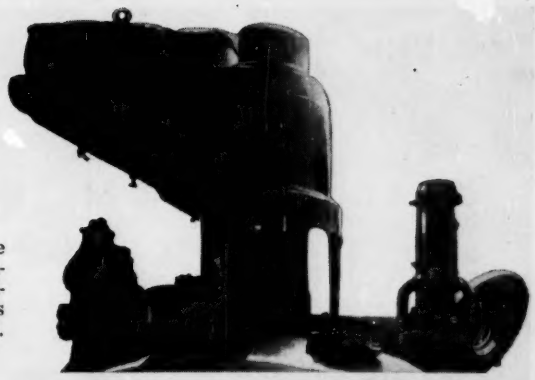
Chemicals commonly used in the Solvay or Olin Mathieson processes have no corrosive effects at all on Glasteel generating equipment.

More than 35 pulp and paper mills find it the most economical equipment they can use when all costs are analyzed.

Tantalum bayonet heaters...100% corrosion resistant

Tantalum bayonet heaters are completely corrosion resistant for practically *all* chemical processing applications.

You get heat transfer area up to 15 square feet, depending on tube size and number in cluster. Also available in large production sizes . . . heat exchangers, vessels, and reactors of tantalum—and of titanium and zirconium, too. (Bulletin No. 978)



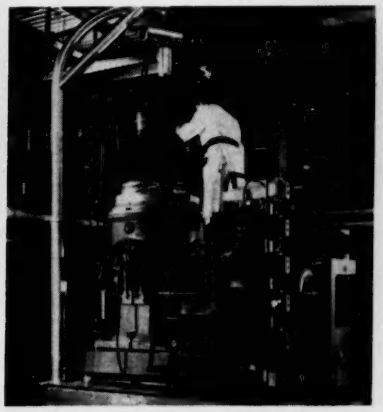
Agitation drive cuts maintenance up to 50%

New Pfaudler BH Drive drastically reduces drive maintenance with these features: fast pilot fit alignment every time, longer-lasting shaft and seal, antifriction bearings, Pfaudlerpac fast changeover seals or stuffing boxes. 12, 30, or 60 HP at 100 RPM. (Bulletin No. 972)

Electronic instrument for safe testing of glassed steel

The new PFAUDLERTRON glass tester—completely electronic—gives you a fast, visual signal when testing for exposed metal.

It has stabilized voltage, two probes (brush and needle point), cannot puncture sound glass or cause dielectric breakdown. (Bulletin No. 970)



Packaged centrifuge for in-plant production line testing

Now you can test our Titan centrifuge in your own production line *before you buy.*

All you need is an available 220/440 three-phase electrical service plus water to test our Titan centrifuge in your own production line with this portable unit.

It has 6000 gal/hr capacity and is complete with required pumps, valves, controls and other accessories.

This first of a series of packaged test units is available on a leasing agreement set to meet your particular needs.

We can also provide technical personnel for setting up and operating your test program. (Bulletin No. 946)

Glassed ductile-iron fittings* with strength comparable to Glasteel's

These glassed-ductile iron fittings have strength 2½ to 3 times higher than that of low-strength gray iron.

Like Glasteel, they have high thermal shock and corrosion resistance.

Available now. (Bulletin No. 977)

*Pat. Pending

FLUIDICS covers such varied phases of fluid handling and control as: **corrosioneering • water treatment • waste treatment • reactions • polymerization • ion exchange • fluid analysis • metering and control • agitation • evaporation • distillation • drying • blending • valving • piping • storing • centrifuging • filling • heat transfer**

When you have a fluid-handling problem, try Pfaudler Permutit FLUIDICS program for the best solution.

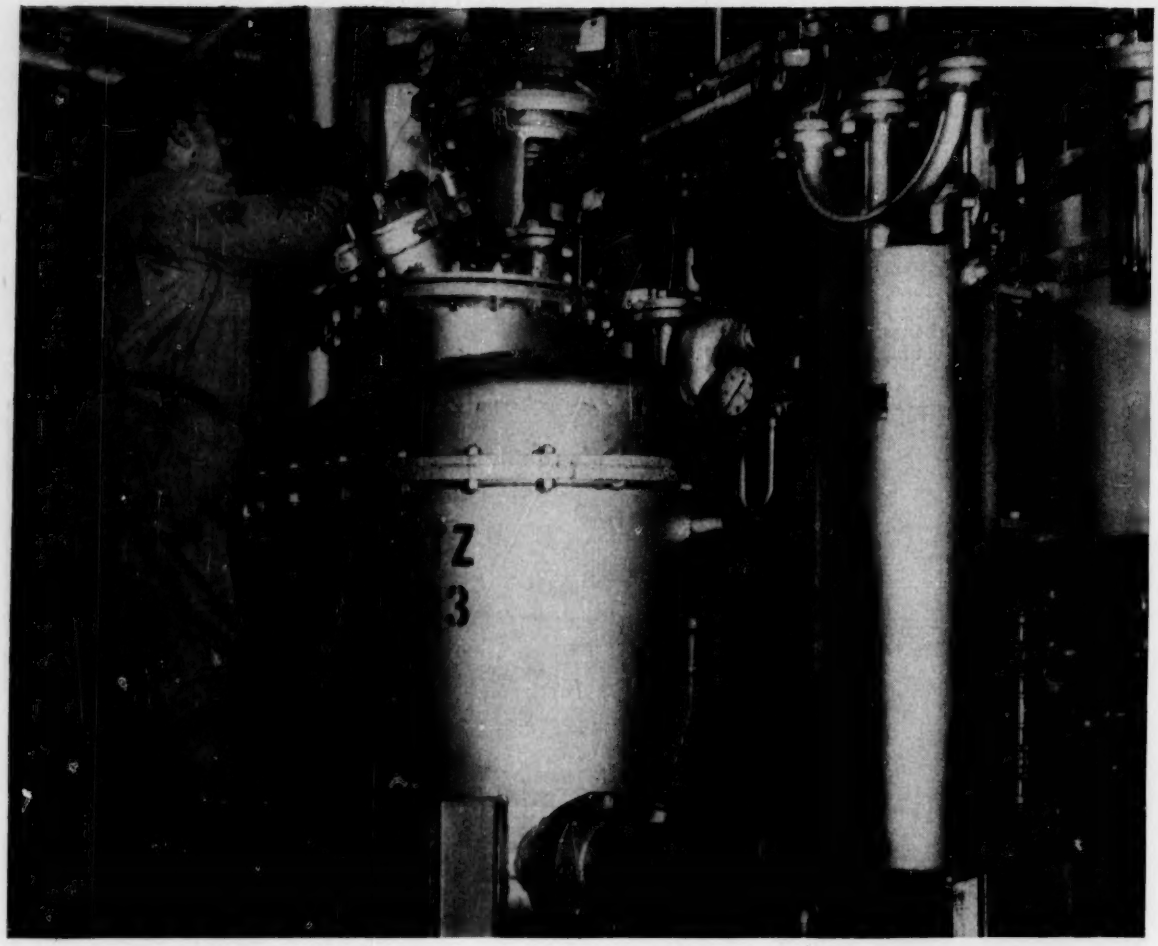
FLUIDICS AROUND THE WORLD

Pfaudler Permutit is a world-wide company with manufacturing plants in Germany (Pfaudler-Werke A.G.), Great Britain (Enamelled Metal Products Corp. Ltd.), Canada (Ideal Welding Co. Ltd.), Mexico (Arteacero-Pfaudler, S. A.), and Japan (Shinko-Pfaudler Co., Ltd.), in addition to our four plants in the U. S.

Write to Pfaudler Division, Dept. CE-79, Rochester 3, N. Y., for more information about the Fluidics program.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . .
the science of fluid processes



Corrosion was ruled out . . . purity protected when Nickel was specified for this 100-gallon still and its two 25-gallon receivers used by Givaudan-Delawanna's Development Department to distill aromatic chemicals and essential oils. Equipment was fabricated by Manning and Lewis Engineering Co., of Newark, N.J.

Delicate new scents! Delicate new flavors! Distilled in corrosion-resisting Nickel they're pure and reproducible

No one quite knows why some scents and flavors catch on and help sell thousands of dollars worth of products.

But what is known is that subtle differences in scents and flavors can definitely affect the popularity of products.

So producers do all they can to keep scents and flavors pure. In developing new ones, purity becomes doubly important . . . for those that catch on must be reproducible.

For this reason, the choice of materials for equipment is especially important to manufacturers of perfume bases and flavors such as Givaudan-Delawanna, Inc., at Delawanna, N. J. In manufacturing pure aromatic products Givaudan relies heavily on equipment made of corrosion-resisting Inco Nickel.

Nickel resists corrosion by the crude product, resists stress corrosion-cracking, and, since it is relatively free from attack, protects against metallic contamination. Nickel is also specified in Givaudan's Development Department because it lends versatility to the equipment, making it possible to process any of the products that may be handled by the department without fear of corrosion or contamination.

Whether you make perfumes or space fuels, Inco Nickel and its alloys are powerful weapons in your fight against corrosion. And Inco's Technical Specialists are on call to help you use them well. Just say the word, if you would like help on a corrosion problem.

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.

*Registered trademark

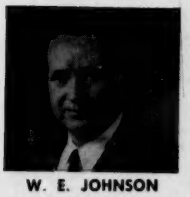
INCO NICKEL ALLOYS

ADVERTISEMENT—*This entire page is a paid advertisement* *Prepared by U. S. Industrial Chemicals Co.*

U.S.I. CHEMICAL NEWS

July ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1959

New Managerial Positions Created in U.S.I. Sales



W. E. JOHNSON

Warren E. Johnson, Vincent D. McCarthy and George H. Stanton have been named to fill three new sales management positions which have just been created by U.S.I.

Mr. Johnson, who is appointed Director of Chemical Sales, will have responsibility for Industrial Alcohol and Solvents, Heavy Chemicals, Sodium and Special Products Sales, with the manager of each product group reporting to him. Mr. McCarthy as Director of Plastics Sales, will have responsibility for management of polyethylene sales, as well as other plastic materials that the company might produce in the future. Mr. Stanton, who will assume the position of Director of Field Sales later in the year, will supervise the activities of regional sales offices. The three new appointees will report to Alden R. Ludlow, Jr., Vice President in Charge of Sales.

V. McCARTHY

G. H. STANTON

"We are confident these important changes will considerably strengthen our sales organization," Mr. Ludlow says, "and enable us to keep pace with our increasing business."

The new Director of Chemical Sales, Warren Johnson, has been Manager of Alcohol and Chemical Sales for U.S.I. Vincent McCarthy, Director of Plastics Sales, has been Manager of PETROTHENE® Polyethylene Sales. And George Stanton, Director of Field Sales, has been Manager of the U.S.I. Chicago Sales Division.

All-Titanium Centrifugal Pumps and Valves Are Now Being Produced

Centrifugal pumps and valves made of commercially pure titanium have been developed to meet the ever increasing need for more corrosion resistant equipment in the chemical industry. Made to order, pumps are available in sizes from 1" x 1" and capacities from ½ gpm. Valves are available in a size range of 1" through 4", and nonlubricated and non-sticking plug valves are also available in sizes of ¼" through 3".

This equipment, designed in titanium specifically for the highly corrosive environments found in chemical plants, is said to be very competitive pricewise with similar units fabricated from nickel-base alloys. The titanium used is a product of Mallory-Sharon Metals, owned one-third by U.S.I.

1958 Aerosol Survey Results Are In; Production of Nonfood Units Estimated at 20% Above 1957

Hair Sprays Still Sales Leader; Dental Cream, Pet Product Sales Large Enough for Separate Statistical Categories.

At the Chicago meeting of the Chemical Specialties Manufacturers' Association this May, it was announced that an estimated 470 million nonfood aerosol units were produced in the U.S. in 1958, with an approximate value of $470 million. This is an increase of 20% over the 1957 estimate of 390 million units. Estimates are based on reports from 45% (95 out of 211) of the known aerosol fillers in the country, plus reports from container and valve makers. By comparison, CSMA estimated 320 million units in 1956, 240 million in 1955, and 185 million in 1954. Industry production has been climbing steadily over the eight years in which surveys have been made, and has been very rapid when compared to most other industries.

The actual number of units reported for 1958 was 341,383,496. For the third consecutive year, hair sprays were in undisputed first place, accounting for 27% of the total units reported. Although only 92.6 million hair spray units show up on the survey, CSMA believes that over 100 million were actually produced. Room deodorants were reported at 49.8 million units, which indicates a continued growth. The 1957 reported figure was 42 million. CSMA believes that insect sprays, room deodorants, coatings and shaving lather were all actually produced in excess of 60 million units last year, although the reported figures are considerably lower.

Two New Statistical Categories

Dental cream, treated for the first time as a separate category, showed 12.9 million

MORE

NONFOOD AEROSOLS REPORTED IN 1958 COMPARED TO 1957

(figures in millions of units)

Product	1958	1957
Hair Sprays	92.6	94.4
Room Deodorants	49.8	42.0
Shaving Lathers	45.3	50.9
Insect Sprays	42.3	41.5
Coatings	30.1	36.5
Colognes & Perfumes	13.6	17.9
Dental Creams	12.9	*
Household Products Other Than Room Deodorants	25.9	28.1
Personal Products Other Than Hair Sprays, Shaves, Dental Creams, Colognes & Perfumes	14.5	12.4
Miscellaneous	14.4	15.6
TOTALS	341.4	339.3

*not reported separately in 1957

Researchers Uncover More Uses of Methionine in Body

Recent work with radioisotopes by the Biology and Medicinal Division of the Argonne National Laboratory has revealed that methionine in the body, when converted to adenosylmethionine, can participate in epinephrine synthesis; react with niacin; enter the brain; and help form spermine, ergosterol and histamine.

New Ultraviolet Absorber Developed for Polyethylene

A new compound now in the process development stage has recently been made available to polyethylene manufacturers for evaluation as an ultraviolet absorber. The material — 2,2'-dihydroxy-2-n-octoxybenzophenone — is compatible with polyethylene because of the long n-octyl chain, and it is said to absorb strongly in the 300-375 millimicron UV range.

In field tests made by the producer with 10-mil polyethylene film, it was found that incorporation of 0.171% by weight of the absorber was adequate to retain 85% elongation after two months' use in an area of strong sunlight.

Currently, carbon black is the only effective UV absorber compatible with polyethylene and used to protect the plastic in outdoor service. The new compound is a pale yellow powder and, if proven successful in practical application, will permit the outdoor use of clear and colored polyethylene goods.

New System Developed For Extruding Metallic Sodium in Wire Form

For many reactions, where small amounts of sodium in wire form are required, there has long been a need for equipment capable of producing wire from the standard one-pound cylindrical sodium brick, with minimum loss and effort.

MORE

July ★ **U.S.I. CHEMICAL NEWS** ★ 1959

CONTINUED *Aerosols*

units. Again, the reported figure is believed to be substantially less than the number of units actually produced. Veterinarian and Pet Products, the other new category on the questionnaire, showed a reported figure of 3 million units. Serious consideration was given by the CSMA committee to the inclusion of food products in the 1958 survey. However, after careful weighing of the various factors involved, it was decided to postpone inclusion until 1959.

U.S.I. Products Used in Aerosols

Two U.S.I. products, ethyl alcohol and polyethylene, have played an important role in the steady growth of the aerosol industry. Anhydrous ethyl alcohol is virtually a universal ingredient in hair sprays, room deodorants, perfumes and colognes, and is widely used in other personal products and in pharmaceuticals now sold in aerosol form. Polyethylene is an important component in packaging, being used for dip tubes and valve parts. U.S.I. provides nationwide distribution of these products, and technical assistance on their use.

Aerosol industry leaders predict a continued rise in the sales curve. One of the largest makers of containers forecast recently that total production of aerosols should reach 555 million units this year.

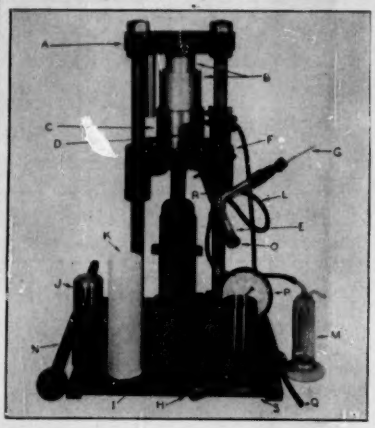
Ethyl Alcohol Permits Two-Color Dyeing Effects On Cotton-Acetate Fabrics

It is reported that in the vat dyeing of cotton-acetate fabrics, ethyl alcohol has been employed to achieve two-color effects by differential swelling of fibers. The fabric is treated at 40°C in a weak alkaline solution containing vat color and 70% ethanol in equal parts.

The acetate fibers are said to take the dye strongly, while the cotton fibers remain practically undyed. Cross-dyed effects can be achieved by dyeing the cotton in a subsequent bath without ethanol. The ethyl alcohol acts by swelling the acetate fibers and depressing any swelling of cotton.

CONTINUED *Sodium Wire*

Researchers at the U.S.I. laboratories in Cincinnati have recently developed such a system, which is described completely in a technical data sheet now available. A photograph of the system, with descriptive legend, appears below. Any laboratory press capable of delivering 10-15,000 psi is suitable.



System for extruding sodium wire: (A) press; (B) body & plunger, 2¼" mold; (C) die assembly; (D) die plate holder & adapter; (E) adapter for cutting sodium wire; (F) clamp; (G) sodium wire cutter; (H) cutter for cleaning oxide layer from feed stock; (I) & (J) bar & knockout rod for pushing plunger from mold body; (K) sodium feed stock; (L) tube for inert gas blanket; (M) bubbler indicating inert gas flow; (N) press oil-pump handle; (O) stopper (when tube not in use); (P) pressure gauge; (Q) inert gas inlet tube; (R) sodium wire.

Sodium wire extruded in this equipment can be used, as an example, for a standard Bouveault-Blanc reduction of diethyl sebacate to decamethylene glycol. In this reaction, carried out with sodium in a considerable excess of absolute ethanol at 85-95°C, the sodium must be added slowly because of its great reactivity with ethanol at the temperatures required. The extruded wire form is ideal for the purpose. Procedure for this reduction is described in detail in the U.S.I. technical data sheet entitled: "Laboratory Production and Use of Sodium Wire," which is obtainable upon request.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Industrial glycols are treated comprehensively in new 80-page booklet now available. Use as antifreezes, coupling agents, humectants, liquid coolants, resin intermediates, solvents described. Properties, handling included. **No. 1490**

A gas chromatography abstracting service has been formed to keep subscribers up-to-date on current developments. Foreign and U.S. journals are searched and technical papers reviewed. Abstracts are submitted on punched cards. **No. 1491**

N-ethyl- and N-methylmorpholine are now being offered as stabilizers for chlorinated hydrocarbons, catalysts for urethane foams, and to prepare corrosion inhibitors, waxes, all emulsifiers and drugs. **No. 1492**

Newly revised chemical elements wall chart now being sold includes newly adopted symbols such as Ar for argon, Es for einsteinium; technical uses of many elements; latest values for atomic weights and other numerical constants. **No. 1493**

Vitamin B_6 is subject of new 40-page brochure. This condensed, up-to-date report gives nutritional and clinical data, plus a review of the chronology, chemistry, pharmacy and occurrence in nature of the vitamin. **No. 1494**

To study animal behavior in response to stimuli, complete range of automatically-recording test equipment is now on market. Permits evaluating effects of psychotropic agents, tranquilizers, sedatives, stimulants, euphoriants. **No. 1495**

New creams said to protect against virtually any skin irritant commonly encountered in industry have been developed. Contain hexachlorophene for bacteriological, anti-fungus effects. Emollient prevents drying, cracking. **No. 1496**

New first aid aerosol spray is claimed to combine antiseptic, germicide, surface anesthetic, surgical dressing and fungicide, all in the one product. **No. 1497**

Synthetic bergamot oil, believed to be first essential oil ever produced entirely and successfully by chemical means, has been announced. Said to have advantages of low and consistent cost, dependable supply, uniformity, freedom from impurities, improved stability. **No. 1498**

New filter paper now being offered is thin plastic (cellulose ester) with millions of tiny pores. Resistant to heat, chemicals; biologically inert. Said to permit large-scale microfiltration to previously unobtainable standards of cleanliness. **No. 1499**

PRODUCTS OF U.S.I.

Alcohols: Ethyl (pure and all specially denatured formulas); Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.

Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Intermediates.

Heavy Chemicals: Anhydrous Ammonia, Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions, Phosphatic Fertilizer Solution, Sulfuric Acid, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide.

PETROTHENE® Polyethylene Resins

Animal Feed Products: Antibiotic Feed Supplements, Calcium Pantothenate, Choline Chloride, Special Liquid CURBAY, Menadione (Vitamin K_3), DL-Methionine, MOREA® Premix, Riboflavin Products, U.S.I. Permadry, Vitamin B_{12} Feed Supplements, Vitamin D_3.

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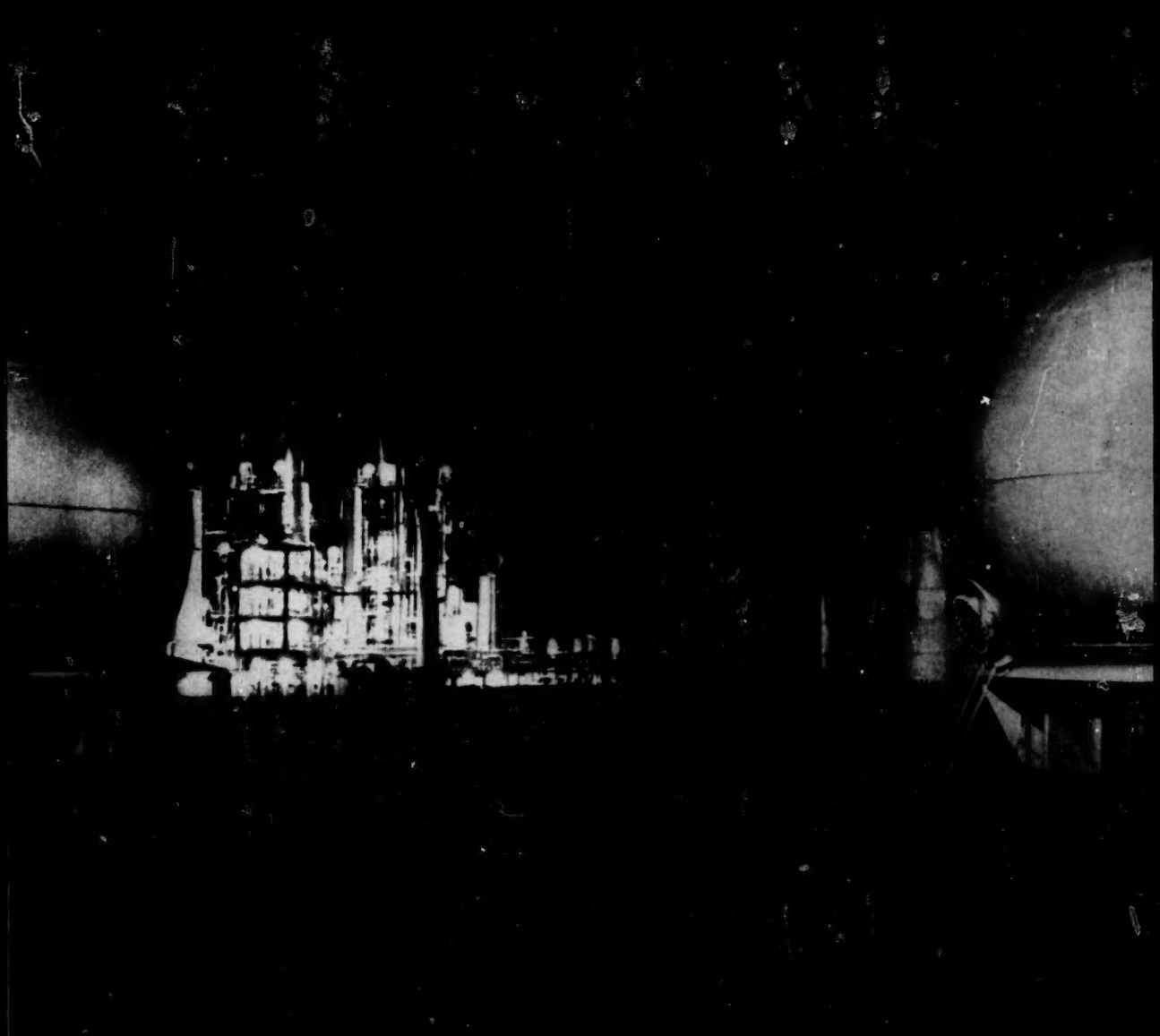


UP TO 30 HOURS' PRODUCTION IN EVERY 24
WHEN **AIR PREHEATERS**® BOOST STILL CAPACITY

You can boost the capacity of your stills by as much as 25% with a Ljungstrom Air Preheater, because an Air Preheater can recover as much as 1000°F from the still exhaust and put this recovered heat back into the combustion air. As a result your fuel burns more completely, at higher temperatures — and you get more product from every hour of still operation.

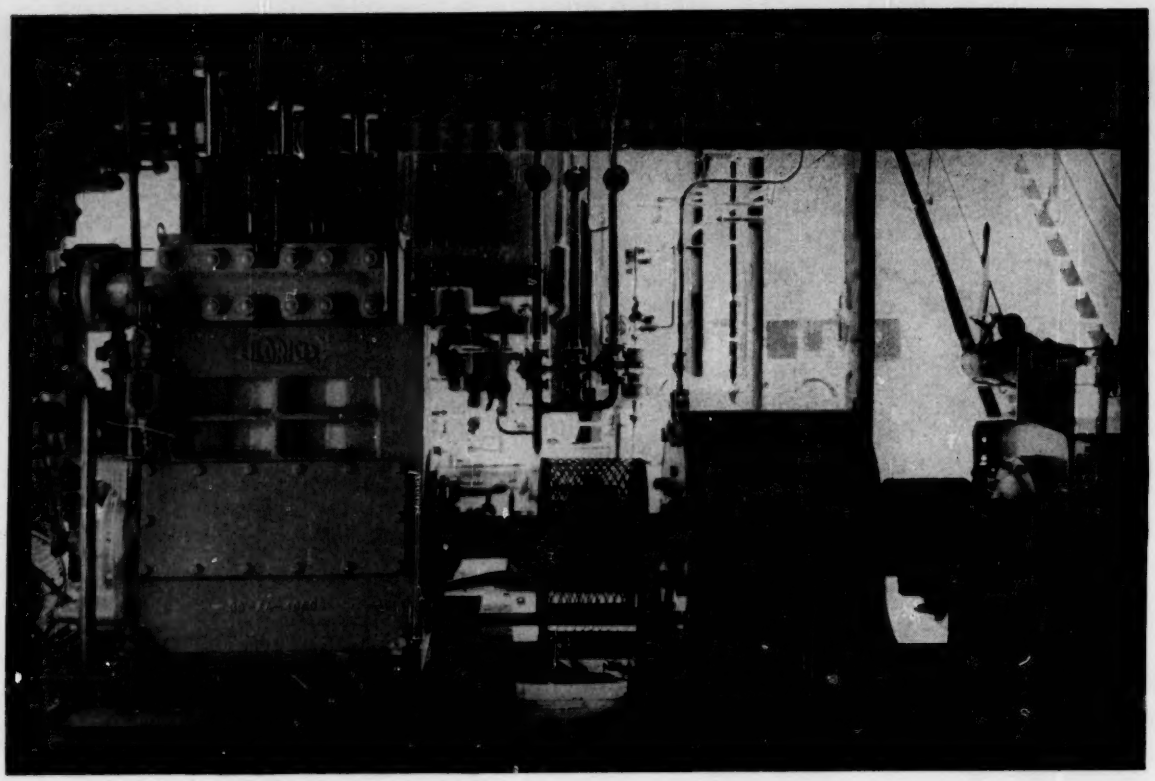
Equipment availability improves with an Air Preheater, too. There's less slag, fewer deposits when fuel burns in preheated air. Oil tubes stay clean, stills stay on-stream months longer, with less downtime for routine maintenance.

Air Preheater saves money other ways, too. If you're refining corrosive crudes or operating stills at very high temperatures, consider replacing all or a part of your convection surfaces with an Air Preheater. That way you minimize your need for expensive heat- and corrosion-resistant alloys, and get up to 25% savings on fuel bills.

One company's fuel savings with a Ljungstrom Air Preheater are factually described in a published magazine article by O. F. Campbell. Write today for your free copy to The Air Preheater Corporation, at the address below.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



THE PRESSURES ARE HIGH...THE LIQUIDS CORROSIVE...THE PUMPS ARE ALDRICH...

At the Houston plant of Rohm & Haas Co., this Aldrich pump alternately introduces caustic and brine into one phase of the acrylate process for producing acrylic monomers.

The problem: Handle highly corrosive liquids at 3000 psi in a continuous process and *not* have severe maintenance problems.

What Rohm & Haas did about it. Company engineers specified Aldrich 1⅝" x 5" stroke Triplex Pumps for three reasons.

1. Compact, heavy-duty construction makes Aldrich pumps ideal for high pressure service.

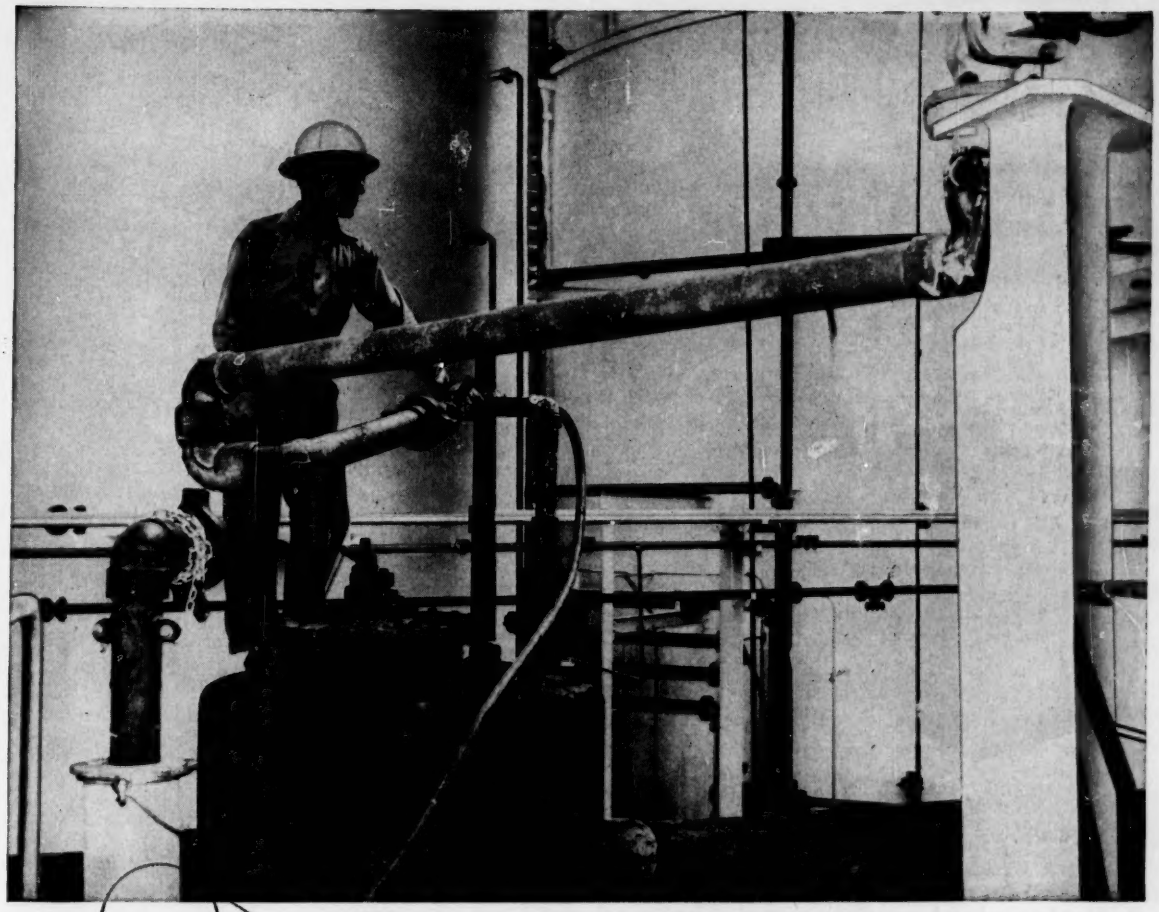
2. Aldrich pumps are designed for easy maintenance. Fluid-end sectionalization permits quick removal of valves for inspection or replacement. No special tools are required.

3. Aldrich engineers can draw upon a vast store of experience when it comes to selecting the right materials for any pumping job. In this case, the entire fluid end . . . working barrel, suction and discharge manifolds . . . are forged Monel. Valve seats are Haynes Stellite. Valves and plungers are K Monel.

Results: According to the Plant Manager of the Houston plant, "maintenance requirements have decreased and pumping production improved. These Aldrich pumps lend themselves to easy maintenance."

How Aldrich can help you. Solving pumping problems like this requires specialized engineering skills and experience. We have those skills, and our experience comes from years of working with the chemical industry. We welcome the opportunity to discuss your specific problems . . . no matter what the liquid or how high the pressures. Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

the toughest pumping problems go to ALDRICH

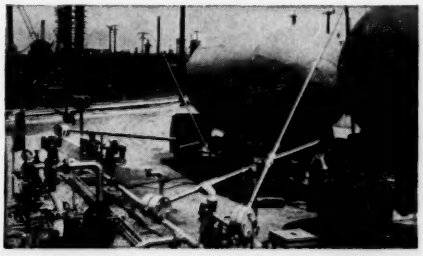


IN FLUID HANDLING—

CHIKSAN

LOADING ARMS

give hard-to-handle liquids a
SAFE SEND-OFF . . .



Chiksan Loading Arms deal with hard-to-handle corrosive chemicals, hydrocarbons, and other fluids and gases, speedily and safely, in all kinds of weather.

Chiksan Loading Arms, with their versatile ball-bearing swivel joints, combine unlimited flexibility with the safety and longevity of metal. With Chiksan there's never a problem of hazardous, often costly, line rupture loss. In fact, whatever fluid you are handling, you get longer life, spend less on maintenance, with Chiksan Loading Arms. Write for descriptive literature today.

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc

CHIKSAN

CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Company • Chiksan of Canada, Ltd.

Low in cost...
easiest to program and operate...
most in demand

Optimize plant equipment design and product blend!

The powerful, compact LGP-30 provides you with fast, accurate answers in all types of statistical studies – analysis of variance, regression analysis, etc. – also allows you to optimize heat exchanger, distillation column and other equipment design. Other important CPI jobs include mass spectrometer analysis and refinery process simulation. Solutions are printed out in any desired alpha-numeric format – require no deciphering. Result: the LGP-30 relieves you of the tedium of detailed calculation . . . allows you to handle more assignments . . . frees your time for further creative work.

The LGP-30 offers you capacity comparable to computers many times its size and cost. It has a magnetic drum memory of 4096 words and is by far the easiest computer to program in basic machine language. The LGP-30 operates from any convenient wall outlet . . . requires no special installation or air conditioning. Auxiliary high-speed input-output equipment is available for increased operational speed.

Backed by 20 years of electronics experience, LGP-30 sales and service are available through Royal McBee offices coast-to-coast. Customer training is free. An extensive library of programs and sub-routines is available (including Box technique for experimental design) – as well as membership in an active users organization.

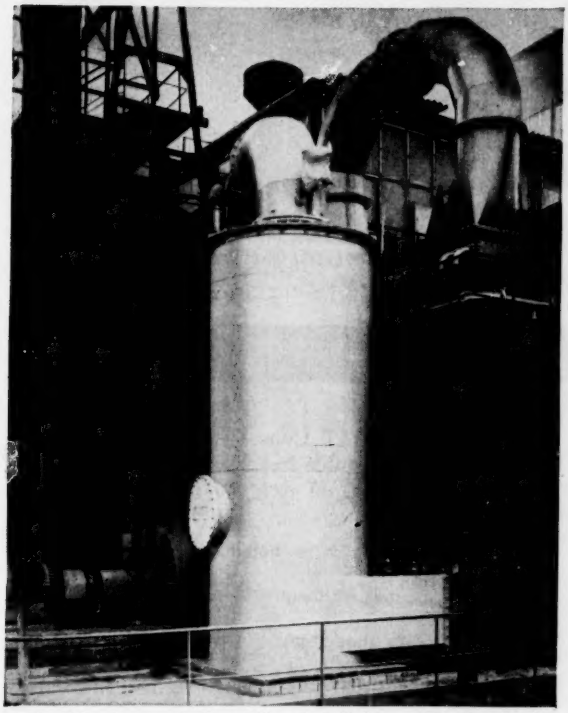
For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N. Y. In Canada: The McBee Co., Ltd., 179 Bartley Drive, Toronto 16.

ROYAL McBEE · *data processing division*

AIR POLLUTION

growing problem in the chemical industry

Chemico Gas Scrubbers offer practical solution in variety of CPI applications



The Chemico venturi scrubber installed on this phosphoric acid plant removes and recovers better than 99% of the phosphoric acid mist. In this instance, both venturi and cyclonic separator are rubber-lined to withstand the effects of the acid.

FULL DETAILS AVAILABLE

For your copy of a new brochure giving complete data on Chemico venturi gas scrubbers or for technical assistance on a specific problem, write to the address below.

Dusts, fumes and mists—the unavoidable by-products of many industrial processes—often create tremendous public relations and legal problems. The chemical industry is now taking vigorous steps to remove these nuisances.

One such step has been the application of Chemico venturi gas scrubbers which remove sub-micron as well as plus-micron particles from gas streams, thereby eliminating the polluting elements. These units are based on the Pease-Anthony venturi principle which has been modified and improved by Chemico.

• • •

OUTSTANDING PERFORMANCE ON DIFFICULT PROBLEMS

Typical of the success of Chemico venturi gas scrubbers has been their recent application to sulfuric acid concentrators which have long been a source of air pollution. By the use of this equipment, better than 99% of the acid mist can now be removed, thus solving this difficult pollution problem.

SIMPLE CONSTRUCTION PERMITS WIDE APPLICATION

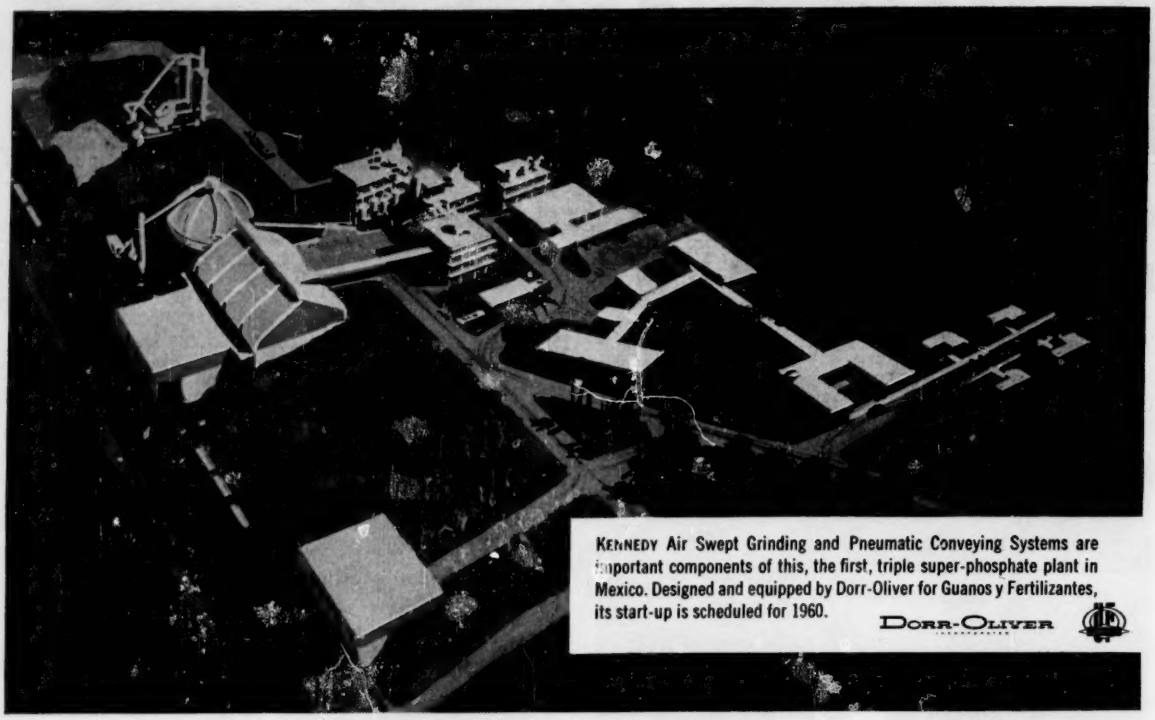
The simple design of Chemico venturi gas scrubbers allows for use of materials resistant to corrosion, abrasion or high temperature. This, plus their small space requirements, permits installation in existing plants handling corrosive materials as well as incorporation into new plant designs. In addition, no critical controls are required and maintenance costs are reduced to the barest minimum. Chemico venturi scrubbers have been proven for use in acid concentrators, copperas roasting kilns, chlorosulfonic acid plants, dry ice plants, phosphoric acid plants and many other chemical manufacturing operations. These are the same scrubbers which won such wide acceptance in the iron and steel industries.

CHEMICO

CHEMICAL CONSTRUCTION CORPORATION
525 West 43rd Street, New York 36, New York

CHICAGO • DALLAS • HOUSTON • PORTLAND, ORE. • TORONTO • LONDON • PARIS • JOHANNESBURG • TOKYO

KENNEDY for grinding & conveying phosphates



KENNEDY Air Swept Grinding and Pneumatic Conveying Systems are important components of this, the first, triple super-phosphate plant in Mexico. Designed and equipped by Dorr-Oliver for Guanos y Fertilizantes, its start-up is scheduled for 1960.

DORR-OLIVER

KENNEDY Ball Mills are noted for high tonnage and low cost processing of phosphate rock and other agricultural chemicals:

- Lowest maintenance cost—cannot be jammed or damaged by tramp iron or other foreign material
- No periodic shut downs for wearing part replacement
- Grinding media is replaced without interruption
- High capacity and product fineness remain constant—month after month
- Careful basic design and pressure lubrication assure high mechanical efficiency
- Reliable feed control and overall reliability provide high production with minimum manpower
- Higher capacity in single units—less space and structural steel per ton of capacity and lower initial investment.

KENNEDY AIR-FLOAT Conveyors provide trouble-free air-gravity conveying of dry materials:

- There are no moving parts—nothing to wear—nothing to maintain
- Only small volumes of low pressure air are needed—uses less power
- Operates quietly—has high capacity—requires little headroom
- The conveyed materials are completely enclosed—there is no dust
- Permits flexible design—directional changes are simple
- Can be made from corrosion resistant alloys
- Eliminates lubrication, complicated gears, belts and chains, spare parts and down time for maintenance.

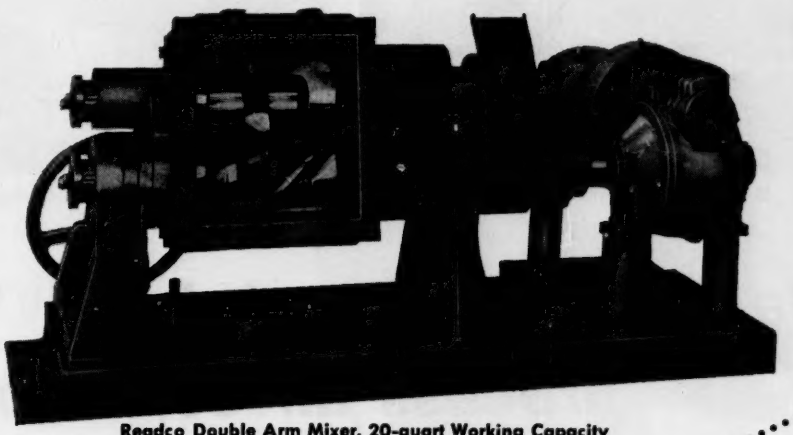
Consult KENNEDY for further details. Let us show you the many advantages KENNEDY equipment can offer you.

KENNEDY VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.

Primary & Secondary Gyratory Crushers • Jaw Crushers • Roll Crushers • Impact Breakers • Hammer Mills • Rod & Ball Mills • Kilns • Dryers • Screens • Mechanical & Pneumatic Conveyors • Complete Crushing, Lime, Cement & Carbon Paste Plants. KENNEDY Research & Testing Service.



Readco Double Arm Mixer, 20-quart Working Capacity

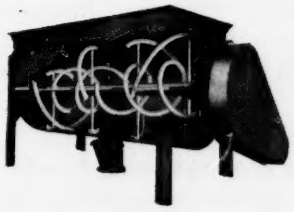
Predict production precisely with READCO Lab and Pilot Plant Mixers

Incorporating all the basic design features of larger production models, Readco Laboratory and Pilot Plant mixers enable you to make accurate forecasts for commercial processing.

Mixing bowls are accurately machined and fitted . . . have vacuum covers and temperature controlling jackets. Overlapping sigma mixing arms are held in constant close clearance, eliminate dead spots, prevent build-up of materials, aid temperature control. Easily interchangeable mixing arms adapt to various materials or processes.

Ruggedly built of Type 316 stainless steel, or any commercial alloy, Readco lab and pilot plant mixers will efficiently handle even heavy viscous material. They are available from stock in 1, 3, 6, 20 and 40-quart working capacities, with fixed or variable speed drives. For more information see Chemical Engineering Catalog, pages 1567-1574D . . . or write direct.

READCO



Readco Spiral Ribbon Mixers—Batch or Continuous. Standard sizes 1 to 500 cu. ft. working capacities.

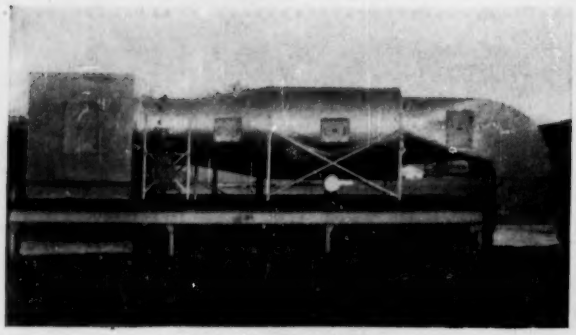
Readco Vertical Mixers, planetary action, multiple speed, 12 to 175 qt. working capacities. (Model K-20 illustrated)

Whatever the mixing job . . . a READCO mixer!

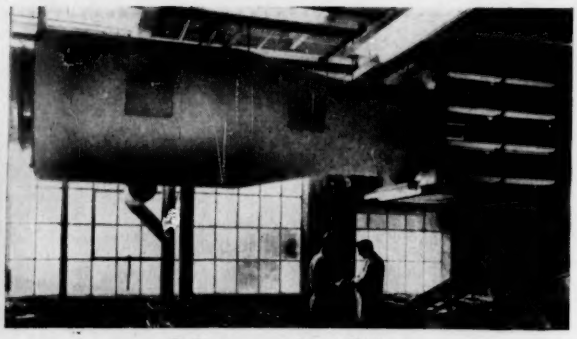
READ STANDARD

York, Pennsylvania

A Division of Capitol Products Corporation

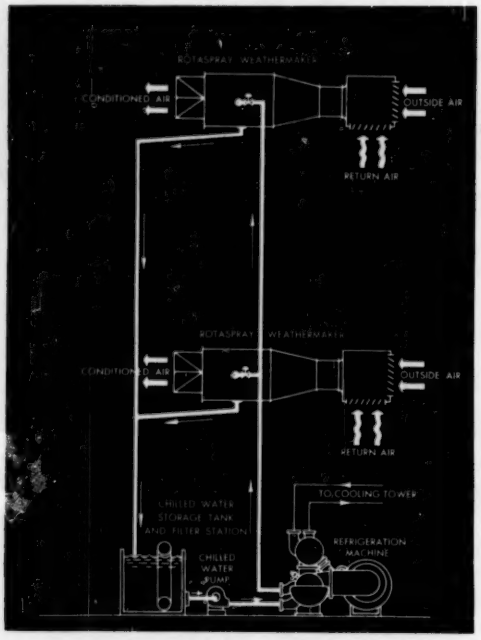


Roof-top Rotaspray installation



Ceiling-mounted installation

Major breakthrough in process air conditioning...



Rotaspray units are self-cleaning, and require no filters. A single refrigeration machine with chilled water storage tank and filter station will handle a multiple unit system with units located at many remote points. Each unit provides individual control of temperature and humidity.

CARRIER ROTASPRAY WEATHERMAKER SYSTEM*

This revolutionary new Carrier air conditioning system is now available to the chemical industry. Its superiority has been proved by four years of field operation on many different installations. Compared with past systems, it provides better control, it lowers construction and maintenance costs —and occupies less space.

Operating at high air velocity (2600 fpm) Rotaspray units are only ⅓ as large as conventional air treating apparatus for the same capacity. Furthermore, they can be located out of doors, with no protective shelter. For system arrangement, note the diagram at left.

Each Rotaspray unit is made of stainless steel for long life. Each provides superior control of temperature and humidity, and offers unequaled ability to meet load variations in the area it serves. Units are compact and light, can be hung from the ceiling, put on the roof or suspended outside on the wall. Four sizes: 10,500 to 30,000 cfm.

For complete information on this new system, call the Carrier office near you. Or write Carrier Corporation, Syracuse, New York.

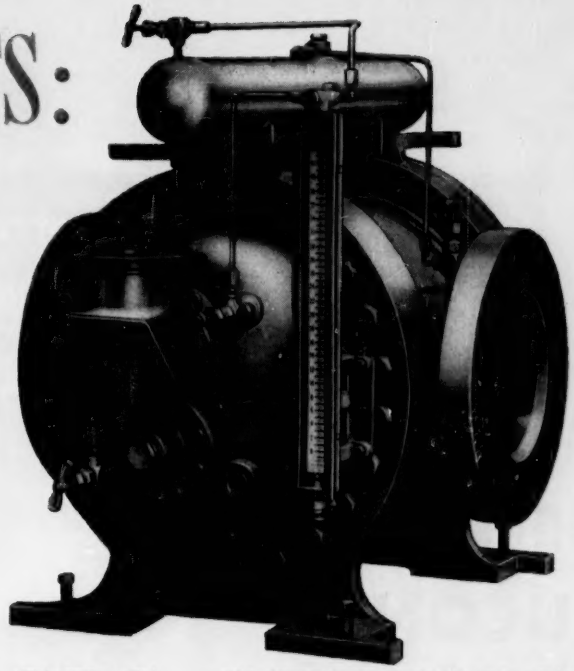
*Pat. Pending

MORE PROOF OF
BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

Carrier

R-C PRESENTS:

a new line of high-pressure rotary gas meters



FOR 600 PSIG SERVICE

A new line of 600 psig rotary positive displacement gas meters has been developed by Roots-Connersville to serve the needs of industries requiring extreme measurement accuracy in the higher pressure ranges. The meters are available in 4 sizes covering a range of from 84,000 to 1,600,000 scfh.

THIS NEW METER LINE IS IDEAL FOR MANY APPLICATIONS:

- City Gate Metering
- Transmission Line Metering
- Process Gas Metering
- Chemical Gas Manufacturing
- Gas Lifting
- Compressor Stations
- Well Head Measurements
- Steel Mills
- Underground Storage
- Metering of pulsating flow and surges, H2, 02, C02, NH3, LP gas, NO, He, C2H2, etc.

R-C rotary gas meters require an absolute minimum of maintenance . . . assure almost complete freedom from wear . . . exceptionally high accuracy in metering. A refinement of the basic R-C rotary-positive design which has proved its dependability over the years. These new meters for 600 psig service have incorporated simple in-the-line mounting, straight through flow . . . high-speed gears . . . and a welded steel outer case enclosing a steel inner cylinder. Throughout their extra wide operating range, these new R-C meters assure greater accuracy and improved performance in handling a wide variety of gases.

The development of this new meter is another example of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

Write us for additional information and data sheets about these new Roots-Connersville meters for 600 psig service.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
759 Illinois Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto

. . . in wet dust control

NEW DUCON DYNAMIC WASHERS

RECOVER DIFFICULT DUSTS EFFICIENTLY AND ECONOMICALLY

Ducon UW-4 Dynamic Wet Dust Collectors have added a new dimension in dust recovery. They have replaced, with outstanding success, many more costly and less effective dust collectors in the recovery of "difficult" materials, such as fine and abrasive dusts in kilns, rotary driers and other applications.

The UW-4 Washers are also ideal for high loading conditions where maximum efficiency is desired.

Ducon UW-4 washers offer other unique advantages, including constant air capacity, low water consumption and rugged construction. They are self-cleaning and fire and explosion proof.

For complete information write for Bulletin W-7456.

DUCON — DUST CONTROL SYSTEMS AND EQUIPMENT

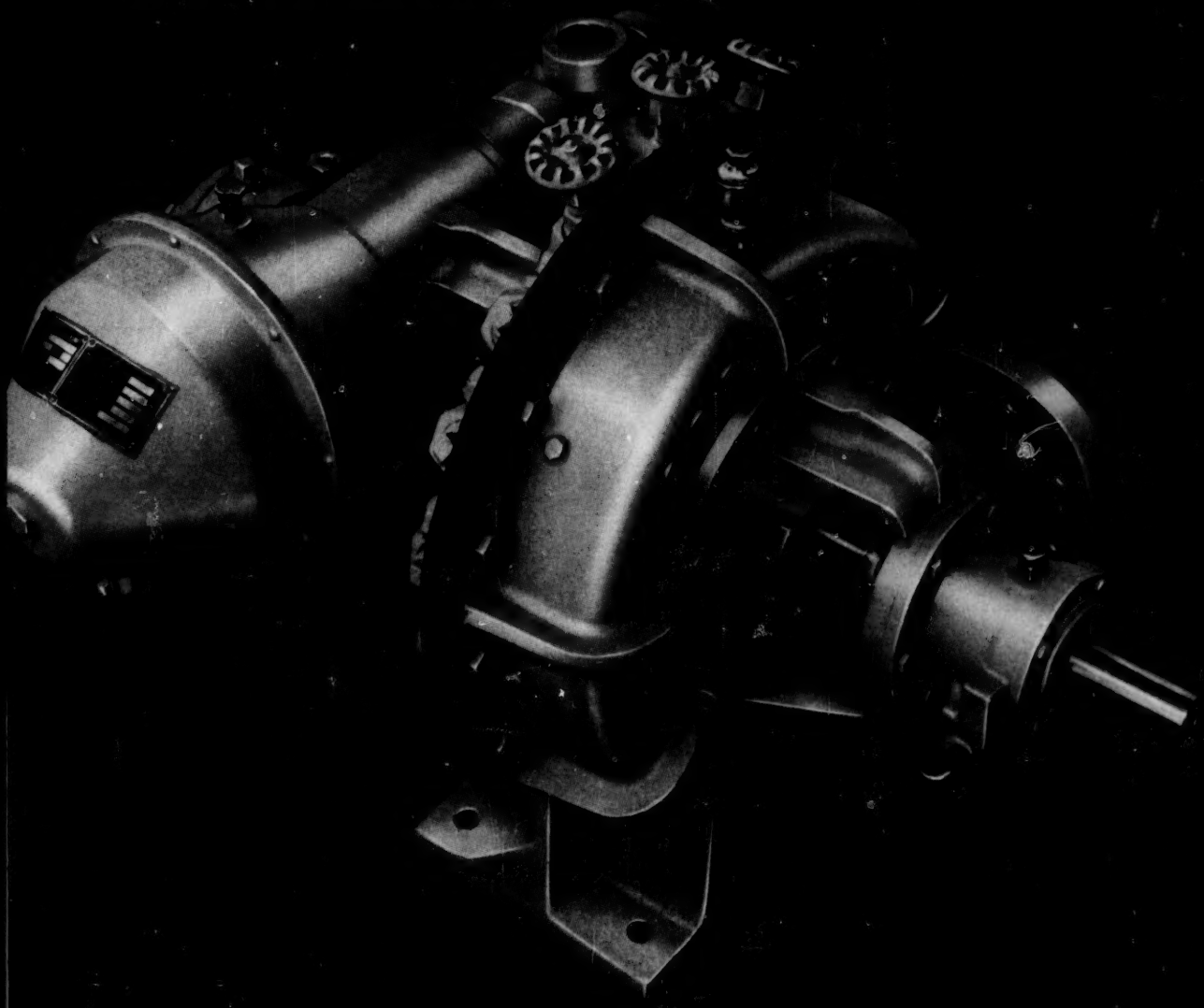
the name in DUst CONtrol

THE Ducon COMPANY INC.
147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

Canadian Branch:
THE DUCON COMPANY of CANADA, Ltd.,
1131 Pettit St., BURLINGTON, ONTARIO

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

COPPUS BLUE RIBBON PRODUCTS



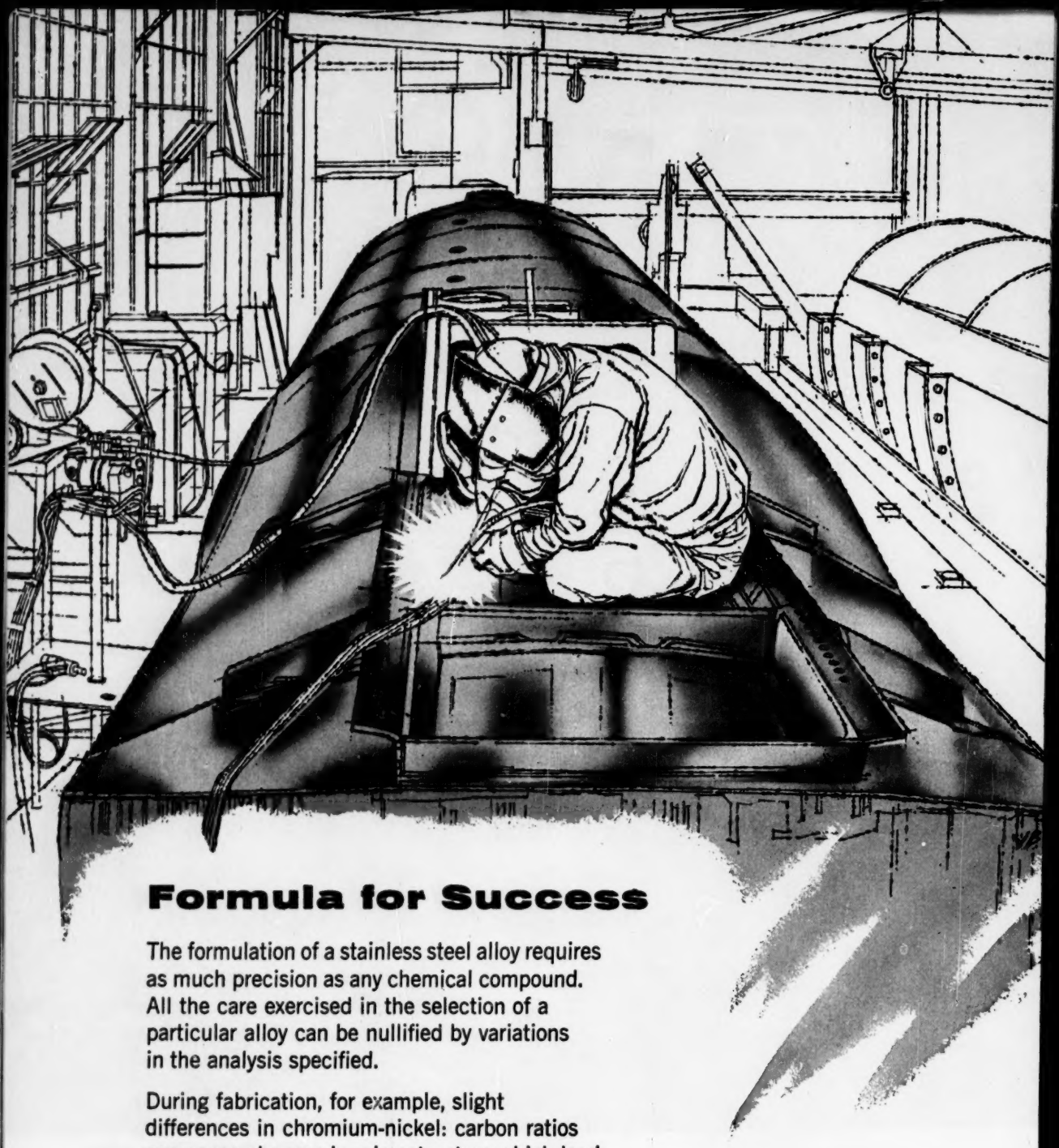
Coppus Horizontal Steam Turbine

NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY!
Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 228 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES



Formula for Success

The formulation of a stainless steel alloy requires as much precision as any chemical compound. All the care exercised in the selection of a particular alloy can be nullified by variations in the analysis specified.

During fabrication, for example, slight differences in chromium-nickel: carbon ratios can cause changes in microstructure which lead to early failure.

That's why it is safer to specify J&L Consistent Quality Stainless Steel. J&L leads the industry in melt shop standards for stainless steel—the point where quality starts, **and longer service life begins.**

Plants and Service Centers:
Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

J&L
STAINLESS
SHEET • STRIP • BAR • WIRE

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34

GPE Controls

LIBRATROL·500

...the complete digital process control computer packaged for on-line applications

The LIBRATROL-500 is the equivalent of a 3-shift engineering staff, available to analyze and/or control every function of your plant, for continuous improvement of productivity, cost, and product quality.

Most modern process control systems can utilize the GPE Controls LIBRATROL-500 for logging, supervisory or closed-loop control—at little additional cost. This is because the basic standard LIBRATROL-500 package is *complete*—including input and output, scanning, computing, and logging functions tailored to process control requirements.

The LIBRATROL-500 digital control computer is priced at $84,500 complete. Other models also made by Librascope are available.

Write for complete details about the **GPE Controls LIBRATROL—500** and its application to process control systems

Specifications of Standard

LIBRATROL·500

PROCESS CONTROL COMPUTER

INPUTS

Continuous multiple-switched electrical signals from temperature, pressure, flow, composition, pH, etc.
QUICK ACCESS LOOP: 64-word recirculating register for parallel input, computation, and output.
SPEED: 66 samples per second.
NUMBER: 8, expandable to 512 with additional optional plug-in components.
SEQUENCE: By computer command; changeable by program.
VOLTAGE RANGE: 0-1 and 0-10 (or more) volts d.c.
MANUAL: Flexowriter and punched paper tape.
DIGITAL CLOCK: Internal, pure binary, real time to provide time of day for logging.

OUTPUTS

Flexowriter and punched paper tape; and computer logic producing 10-bit addressable word to actuate relays for control signals.
SPEED AND NUMBER: 66 outputs per second; time-sharing permits unlimited number.
SEQUENCE: By computer command; changeable by program.
TIME READOUT: From digital clock.
TYPICAL OPTIONAL CONTROL FUNCTIONS AVAILABLE: Alarms, voltage level, bridge balance, relay closure, setpoint, reset rate, proportional band, variable time delay, recorder, plotter.

GENERAL SPECIFICATIONS

COMPUTER TYPE: General-purpose digital.
NUMBER BASE: Binary.
MODE OF OPERATION: Serial.
INSTRUCTION TYPE: Single address.
NUMBER OF DIFFERENT INSTRUCTIONS: 16
MEMORY TYPE: Magnetic drum.
MEMORY CAPACITY: 4096 words.
WORD LENGTH: 30 bits plus sign.
CLOCK FREQUENCY: 136 KC
ADD TIME (Excluding Access): 0.25 milliseconds.
MULTIPLY TIME (Excluding Access): 15 milliseconds.
WEIGHT: 1000 lbs. nominal.
SIZE: 30" x 42" x 60".
POWER REQUIREMENTS: 117 volts (±10%) 17 amperes 60 cycles.

OPTIONAL EQUIPMENT

PHOTOELECTRIC READER: High-speed punched paper tape input for buffer storage.
MAGNETIC TAPE: Storage for additional input, output, and computing information.
MAGNETIC-CORE MEMORY: For quick access to stored data.
PUNCHED CARD INPUT.
LINE PRINTER: High speed data-logger printing 14 digits at a time.
TYPEWRITER SELECTOR: For multistation printout.
RELAY SENSING EQUIPMENT: For changing computer program in accordance with plant or product requirements.
GRAPHIC PANELS: For visual display of information.
CONSTANTS PANEL: Manual digital data insertion or readout for operation by nontechnical personnel.

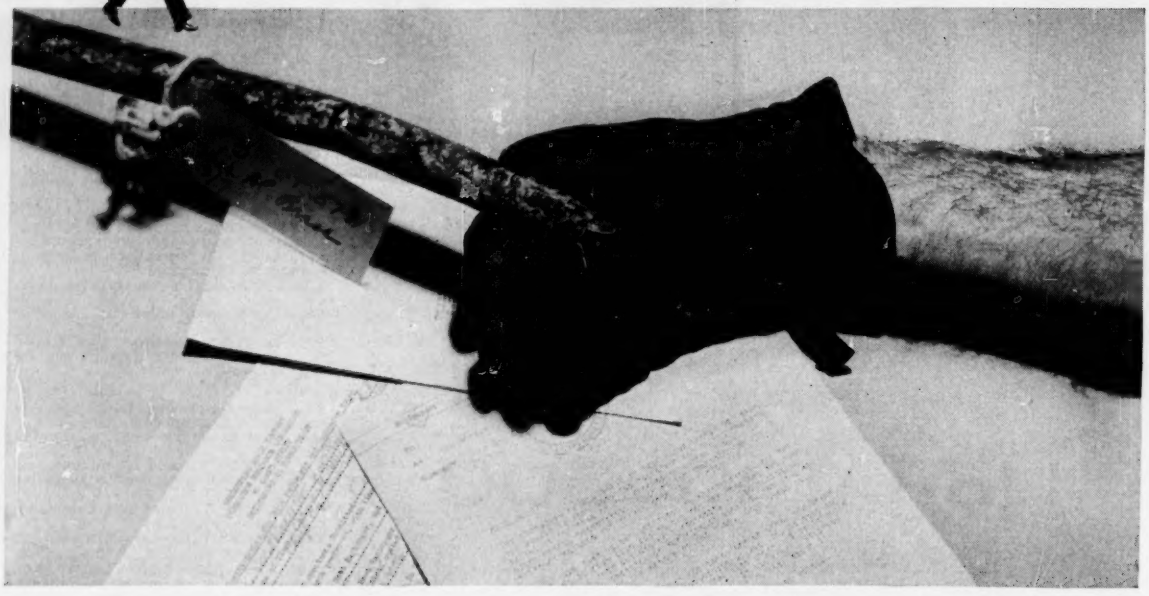
GPE Controls | A GENERAL PRECISION COMPANY

GPE Controls, Inc. (formerly Askania Regulator Company)
240 East Ontario Street • Chicago 11, Illinois

A Subsidiary of GENERAL PRECISION EQUIPMENT CORPORATION

BRIDGEPORT "T" MEN* IN ACTION

**Technical Service Men*



The Case of the Telltale Tube

When the tube came into the lab it was covered with the scars of a savage attack. An obvious case of malicious assault. Accompanying clues were a completed Bridgeport Corrosion Questionnaire and a letter of explanation. The customer—a rendering plant—wanted help fast. He asked for recommendations from the Bridgeport Technical Service Staff.

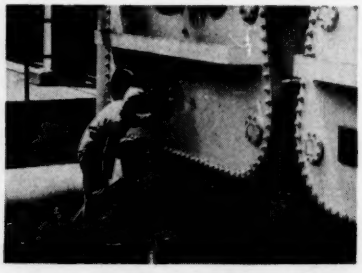
A sample of the tube was rushed to the Spectrograph, an instrument that analyzes 14 elements in less than 5 minutes. Areas of corrosive attack and cracks were examined on a Metallograph. The tube was found to be phosphorized aluminum brass, and tube failure due to stress corrosion from vibration and ammonia on the product side.

"T" Man telephoned customer's chief engineer and notified him of findings. They discussed plant's operation and the products rendered. Neither ammonia nor vibration could be eliminated. From extensive experience in similar cases, "T" Man made several recommendations which would solve the problem. The customer installed Bridgeport 70/30 cupro nickel tube for greater resistance to ammonia and other organic products. Results? Unit operating with top efficiency and economy. No evidence of tube failure since. Case closed.

This is one of many cases from the files of Bridgeport's Technical Service Men. Practical field experience, modern laboratory equipment and expert corrosion engineers assure Bridgeport customers of maximum service and efficiency from their power and process equipment. Learn more about Bridgeport condenser and heat exchanger tubes and services. Call your nearest Bridgeport Sales Office today. (Dept. 5008)

Spectrographic analysis determines tube composition. Can analyze 14 elements in less than 5 minutes.

Metallographic examination reveals type of tube failure from which cause can be determined.



Follow-through—Bridgeport "T" man visits plant to review effects of recommended solutions.

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

BRASS Bridgeport CO.

NOW....PROMPT MOLTEN SULPHUR DELIVERIES

Radiating out from Cincinnati

This is the first of the TGS Terminal Molten Sulphur Truck and Rail Distribution Stations being set up to serve industrial areas of the country. Regular large tonnage barge shipments of Molten Sulphur from our mines in the Gulf area are keeping this Cincinnati Terminal well-stocked to meet the growing demand for Molten Sulphur in the Ohio River area.

Additional Molten as well as Solid Sulphur terminals are being considered for other parts of the country.

TEXAS GULF SULPHUR COMPANY

75 East 45th St., New York 17, N. Y. / 811 Rusk Ave., Houston 2, Texas

Sulphur Producing Units: Newgulf, Texas • Spindletop Dome, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming •

Molten Sulphur in tank *cars* can be delivered to any point in the States or Canada from our nearest mine or recovery plant. Barge deliveries of Molten Sulphur are available on all navigable inland waters. Solid Sulphur, as for many years, is deliverable all over the world. Large inventories at our mines assure industry it will get its supplies when needed.

Evaluating equipment for process application?

Be sure one of the sources you consider is American-Standard Industrial Division

HERE'S WHY: By combining the engineering backgrounds and product lines of three American-Standard* divisions – American Blower, Ross Heat Exchanger, and Kewanee Boiler – the new Industrial Division offers one-source responsibility for quality and performance in equipment that is designed, engineered, and manufactured to work together.

There are engineer-staffed offices in all principal cities to work with architects, consulting engineers, and contractors with equipment selection and on-the-job problems. Contact the one nearest you. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.

Firebox, scotch-type steel boilers and package units for heat, power, steam.

Heat exchangers, condensers, and feed-water heaters for every requirement.

Fluid drives for stepless, adjustable-speed control of driven machinery.

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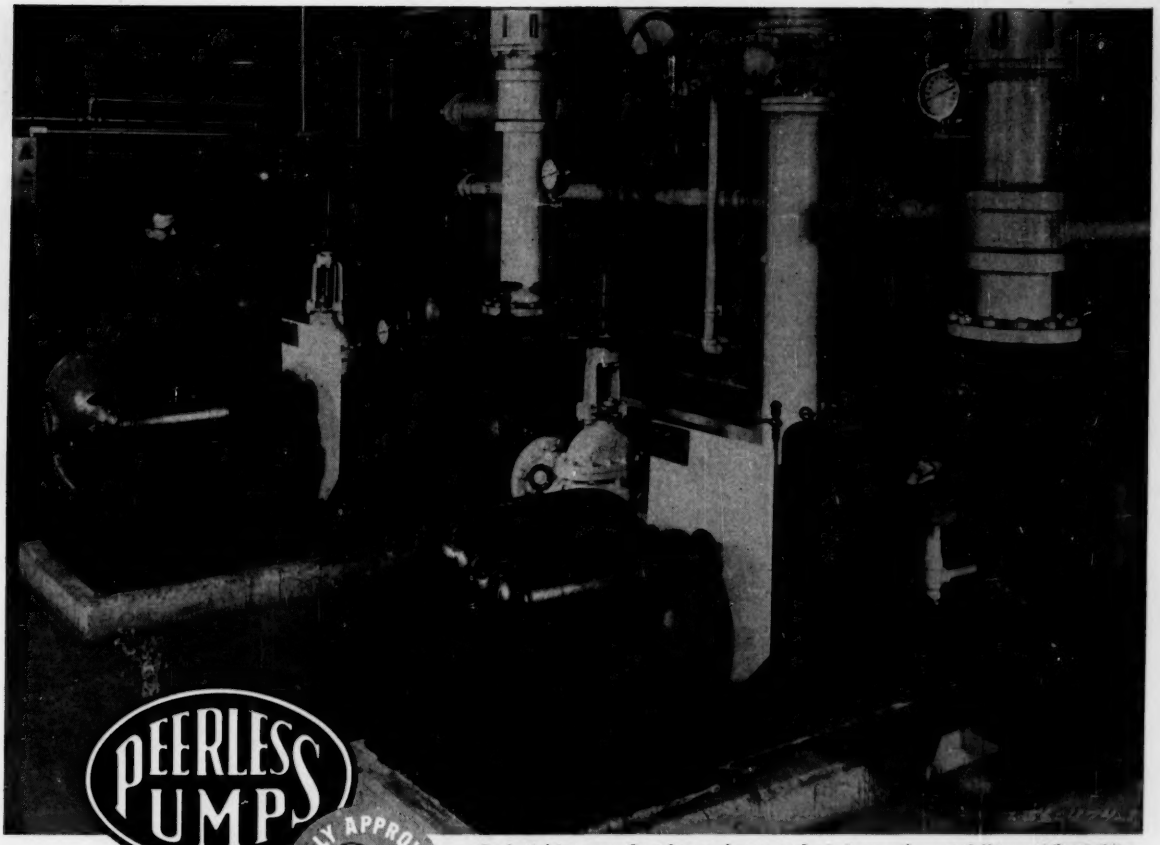
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS



PEERLESS PUMPS

PEERLESS FULLY APPROVED FIRE PUMPS...

FULLY APPROVED UL FM

Prudential Insurance Co. takes no chances on fire in its recently erected Chicago Office Building. Peerless pumps give immediate protection against fire *automatically*, without human attention.

HOW TO DEAL WITH A FIRE BEFORE IT STARTS!

To insure adequate protection against the hazards of fire, a qualified independent fire protection system is a must. And to be doubly sure of the best system, the vital heart of the unit, the pump, should be the best money can buy. That's where Peerless *fully-approved* fire pumps excell.

Throughout a third of a century, Peerless fire pumps have attained an enviable and pre-eminent reputation in protecting all types of buildings, plants and warehouses. Put this know-how to work on your protection problem. See how Peerless' combination of top quality fire pump equipment, exacting engineering application and nationwide service can serve you best. In many instances, the savings effected thru more favorable insurance premiums can pay for the installation. For fire pumps at their very best look to the leader, look to Peerless. Write for bulletin B-1500 today.

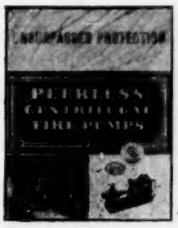
Available with steam turbine, engine or electric motor drives, Peerless fire pumps are available for high pressure sprinkler systems, or foam smothering systems in every kind of commercial, or industrial installation.

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

Peerless Pump Division

Plants:
Los Angeles 31, Calif. and Indianapolis 8, Ind.



PEERLESS PUMP DIVISION
FOOD MACHINERY & CHEMICAL CORPORATION
2005 NORTHWESTERN AVENUE, INDIANAPOLIS, INDIANA CE

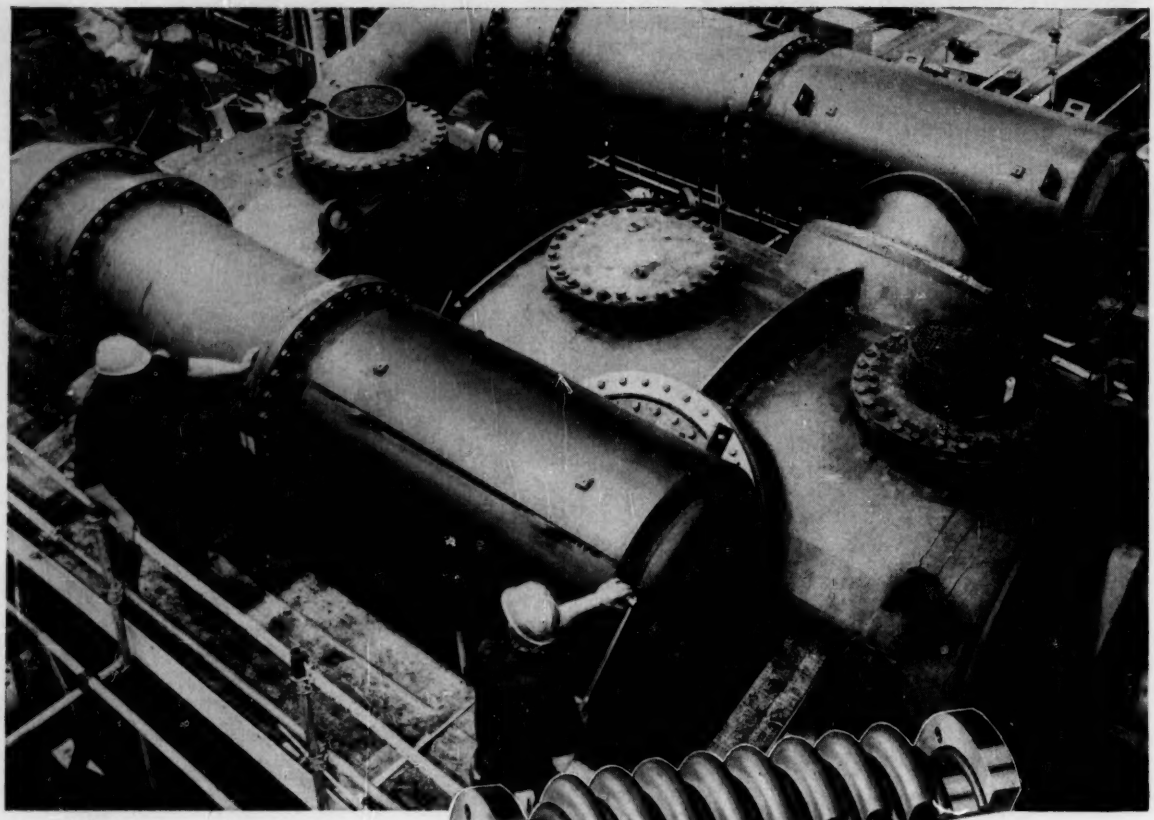
Gentlemen: Please send me immediately a copy of your Bulletin B-1500.

NAME_____

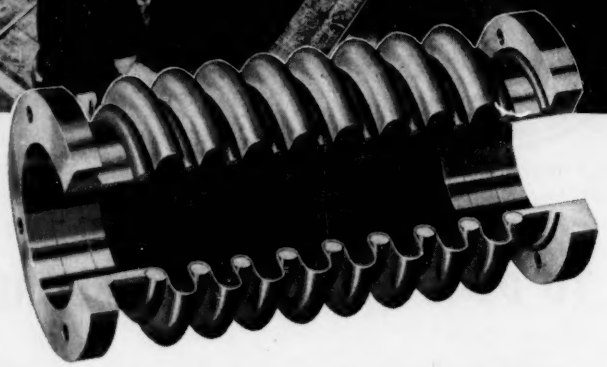
COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____



General Electric steam turbine generator



NEW.. SOLA-FLEX® JOINT!

Unique solid-ring-supported joint withstands pressures to 1200 psi

TWO 36-INCH SOLA-FLEX expansion joints, part of Solar's amazing new solid-ring-supported line, constrain a pressure thrust of 78,000 pounds on the 225,000-kw General Electric steam turbine generator pictured above. Solar's new ring-supported joints offer advantages found in no other design. Solid reinforcing rings are formed integrally with the bellows element. Precise forming and sizing assure higher working pressures, lower stress, longer flexing life. Learn how Sola-Flex joints can serve you. Write to Dept. G-130, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

ENGINEERS WANTED! Challenging projects, unlimited opportunities, good living with Solar. Write today!

1800 gallon grease kettle features a unique gas firing arrangement that preheats blending oils to speed processing of each batch. Vice President and Plant Manager G. H. Goring (at right) and Blaw-Knox Design Engineer W. E. Luley teamed up to create the cost cutting unit.

Buflovak job-engineered kettle handles bigger batches in less time

Since installing a Buflovak kettle, the Ontario Lubricating Company, Ltd., has stepped-up grease production, cut processing time.

Wherever used, Buflovak kettles turn in profit-building performances because they are engineered to accurately meet job requirements.

Buflovak makes many types of kettles, so their engineers can impartially recommend the best unit based on known specifications and the results of product testing. Temperature, pressure, vacuum, agitation, wall thickness, safety and economy are all carefully weighed. And when custom design is essential, Buflovak brings over 30 years of kettle know-how to the project.

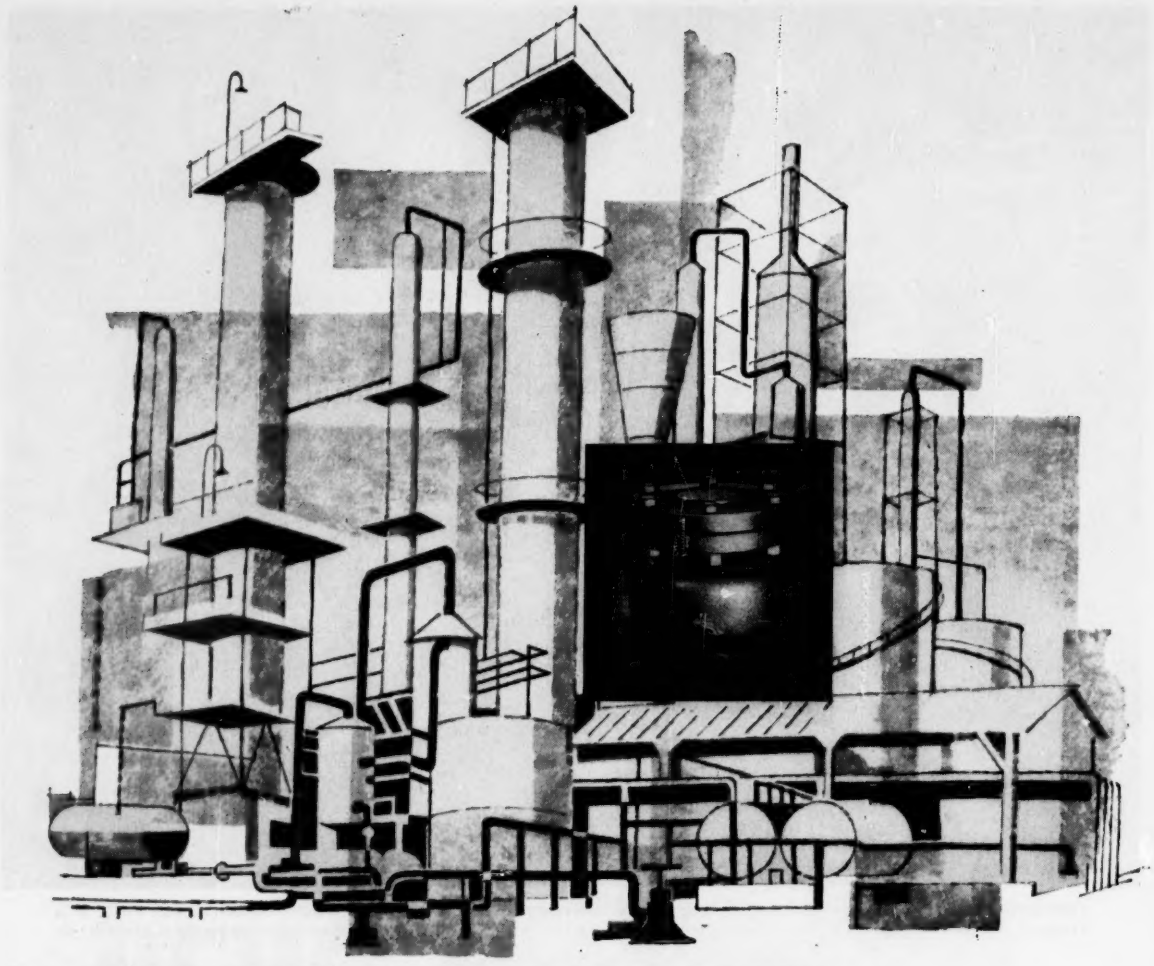
Check your kettle needs at the Buflovak Customer Service Laboratory

If your process is new or untried . . . if you suspect that your operation could be improved, bring your problem to Buflovak's research lab. Here you can work with skilled engineers . . . use the latest in small scale and pilot size equipment to investigate drying, evaporation, extraction, impregnation, crystallization and other related processes.

Write for Catalog 356-R on Buflovak's Processing Kettles, Catalog 381 on the Buflovak Laboratory. Additional facts also available in Chemical Engineering Catalog, pages 429-452.

BLAW-KNOX

BLAW-KNOX COMPANY
Buflovak Equipment Division
1551 Fillmore Avenue, Buffalo 11, N. Y.



THE ECONOMICS OF STEAM TRAP SELECTION

Initial cost versus installed cost

Everybody wants to save money in the purchase of steam traps, or anything else.

But a wise buyer will recognize that the *real cost* relates to the entire useful life of his plant, and that selection of the most efficient trap for a given application is an important consideration.

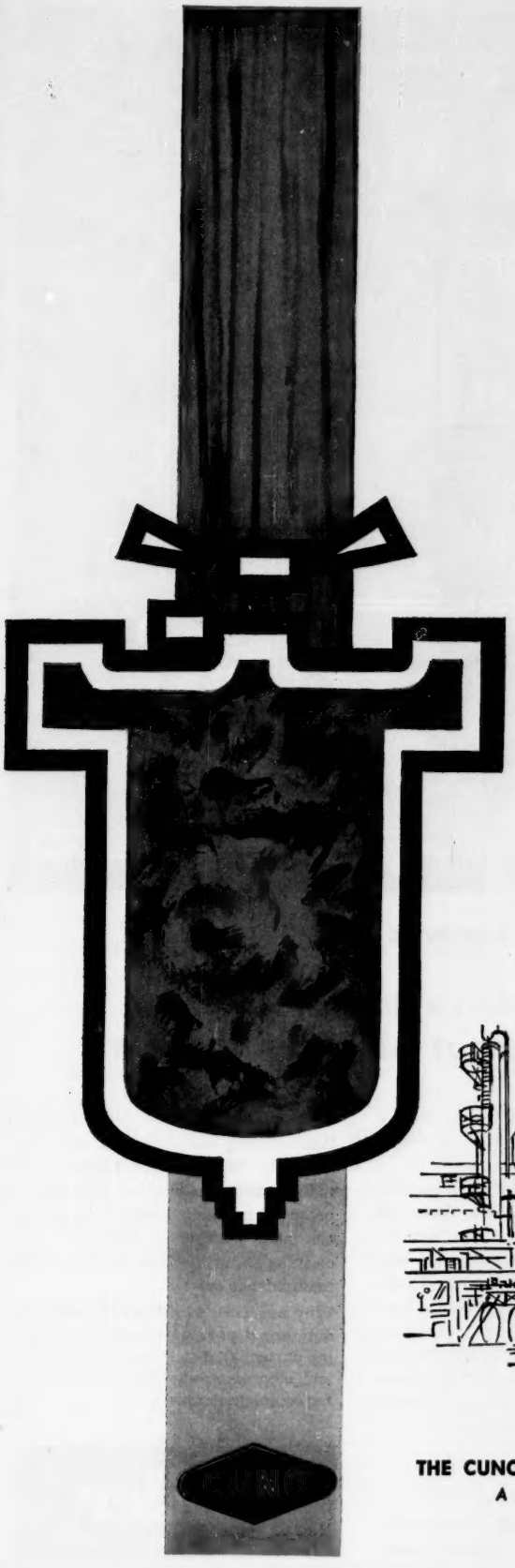
Compare the efficiency of Nicholson traps with that of so-called "bargains" and you'll see why plant engineers responsible for successful operation usually insist on Nicholson.

ST-102

NICHOLSON

OF WILKES-BARRE

W. H. Nicholson and Co. • 16 Oregon Street • Wilkes-Barre, Pa.
Distributors in all principal cities



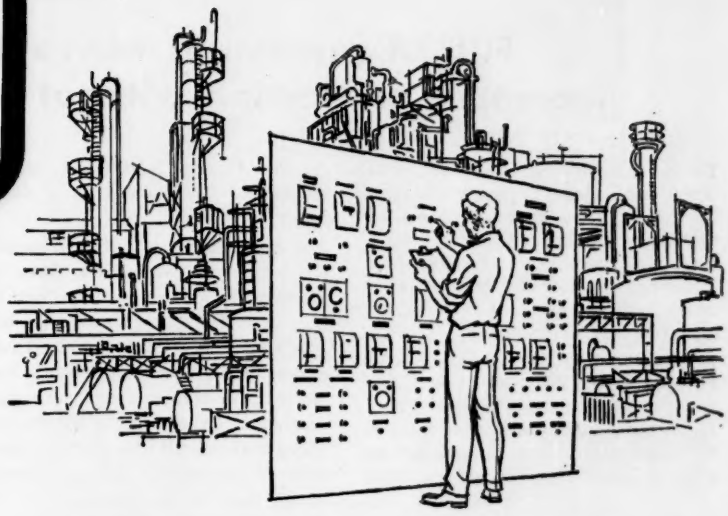
whatever the
chemical process application . . .
you can depend on
CUNO
engineered filtration

Whether you are working with acids, alkalis, solvents, or reactor gases . . . paints, pharmaceuticals, soap or any of a myriad of products which fall within the chemical process field . . . filtration is essential.

This broad scope of applications has resulted in the need for a wide variety of filter types. Cuno offers you a *complete* line to answer the specific requirements of any process application:

- positive self-cleaning edge-type
- automatic self-cleaning wire wound type
- disposable depth cartridge type
- porous metal type
- screen mesh type

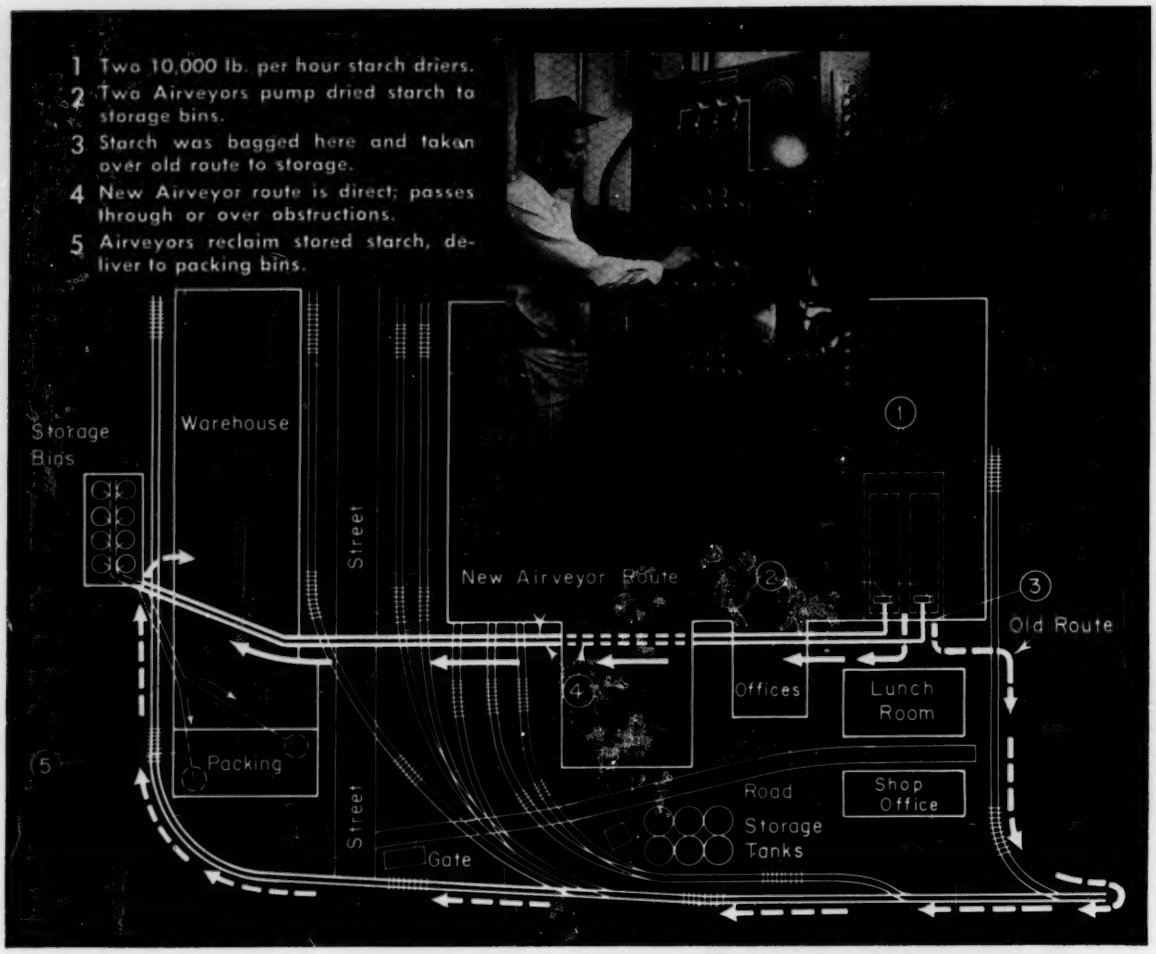
Whenever *you* have a filtration problem, write us. Our engineers will welcome the opportunity to demonstrate how you can *depend on* CUNO.



THE CUNO ENGINEERING CORP., DEPT. 14, MERIDEN, CONN.

A Leader in Industrial Filtration for More Than 30 Years

In Canada: Peacock Bros., Ltd., P. O. Box 1040, Montreal 3, P.Q.



PLANT MODERNIZATION THROUGH PNEUMATIC CONVEYING

FULLER pneumatic conveying system increases production without plant expansion

To increase production, the Union Starch and Refining Company's Granite City, Ill., plant first needed to expand their materials handling system. But a complete revamping of bagging and warehouse operations was impossible because there was no space available for necessary new buildings.

An Airveyor® System, engineered and built by Fuller, was the answer. Airveyor's extreme flexibility allowed it to be set up through walls, along sides of buildings, over streets, on roofs and up inclines. At Union Starch, the total distance covered is 800 feet, with a number of 45 degree and 90 degree bends in the line.

The Fuller Airveyor system transports the starch in two phases, from the driers to the storage bins and from the bins to receiving hoppers over the bagging machines. Flow is controlled automatically through control panels located in the drier room and at the bagging machines. Other controls are also provided at the panels for automatic operation of components such as feeders, blowers, conveyors and filter-receivers.

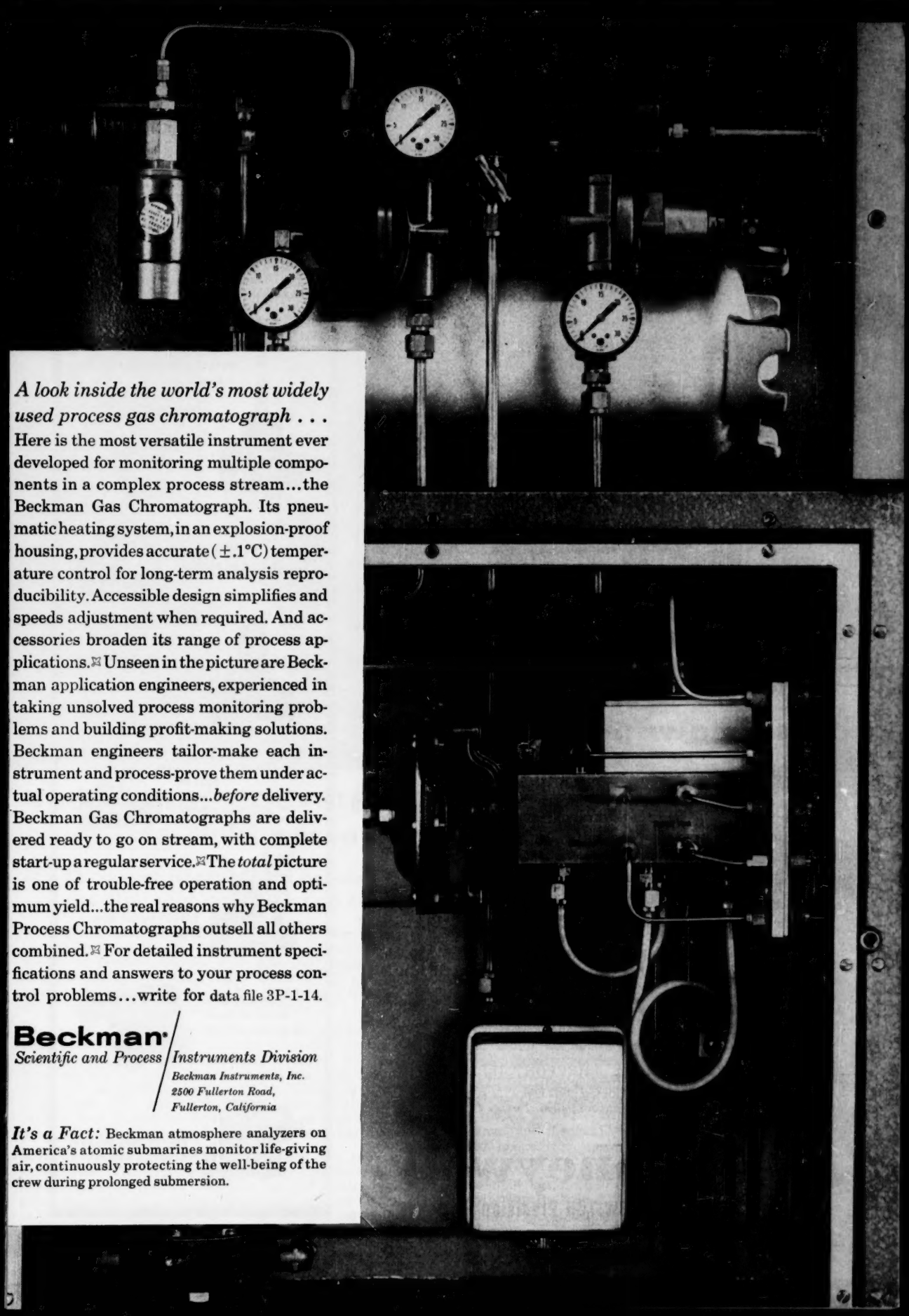
Besides being easily installed and automatically controlled, the Fuller system reduces both the amount and the expense of handling. Additional savings are made possible by Airveyor's self-cleaning facility, which greatly reduces maintenance costs.

Why not work with Fuller to design an automated pneumatic materials handling system that will help you cut costs and increase production? Write today for complete details. A-280 1355

For details on the Fuller Product line, see Chemical Engineering catalog

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
Birmingham • Chicago • Kansas City • Los Angeles • New York • San Francisco • Seattle

Fuller
...pioneers in harnessing AIR

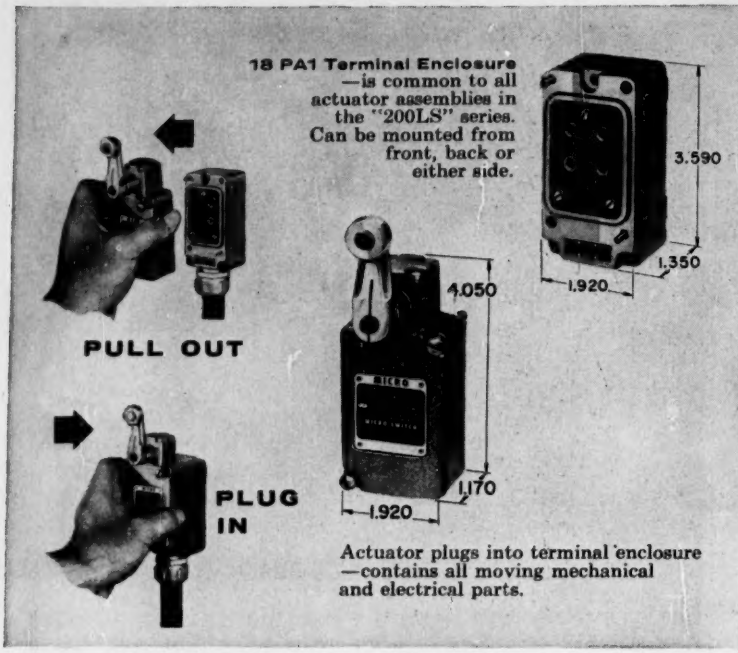


A look inside the world's most widely used process gas chromatograph . . .
Here is the most versatile instrument ever developed for monitoring multiple components in a complex process stream...the Beckman Gas Chromatograph. Its pneumatic heating system, in an explosion-proof housing, provides accurate (±.1°C) temperature control for long-term analysis reproducibility. Accessible design simplifies and speeds adjustment when required. And accessories broaden its range of process applications. Unseen in the picture are Beckman application engineers, experienced in taking unsolved process monitoring problems and building profit-making solutions. Beckman engineers tailor-make each instrument and process-prove them under actual operating conditions...*before* delivery. Beckman Gas Chromatographs are delivered ready to go on stream, with complete start-up a regular service. The *total* picture is one of trouble-free operation and optimum yield...the real reasons why Beckman Process Chromatographs outsell all others combined. For detailed instrument specifications and answers to your process control problems...write for data file 3P-1-14.

Beckman®
Scientific and Process Instruments Division
Beckman Instruments, Inc.
2500 Fullerton Road,
Fullerton, California

It's a Fact: Beckman atmosphere analyzers on America's atomic submarines monitor life-giving air, continuously protecting the well-being of the crew during prolonged submersion.

MICRO SWITCH Precision Switches


18 PA1 Terminal Enclosure
—is common to all actuator assemblies in the "200LS" series. Can be mounted from front, back or either side.
3.590
1.350
1.920
4.050
1.170
1.920
PULL OUT
PLUG IN
Actuator plugs into terminal enclosure —contains all moving mechanical and electrical parts.

201LS3 Adjustable Arm Rotary Actuator Switch
208LS1 Coil Spring Actuator Switch
201LS10 Rod Actuator Switch
205LS1 Roller Plunger Actuator Switch
202LS1 Push Plunger Actuator Switch
201LS1 Roller Arm Actuator Switch
203LS1 Side Roller Plunger Actuator Switch
204LS1 Side Plunger Actuator Switch

Sealed "Plug-in Limit" switches insure against costly downtime

Now available in 8 actuator types

Here's a sealed precision limit switch that can be replaced complete in 20 seconds! Downtime is all but eliminated!

A "Plug-in Limit" switch, in any of eight actuator styles, plugs into the terminal enclosure like a radio tube . . . is precisely positioned by dowel pins and secured by two No. 10 screws. Together, the two parts form a dependable switch assembly, sealed against oil, water, dirt and dust.

The "Plug-in Limit" is two-circuit double throw. Electrical rating is 10 amps. 120, 240, 480 vac; ½ H.P. 120 vac; 1 H.P. 240 vac; 0.8 amp. 115 vdc; 0.4 amp. 230 vdc; 0.1 amp. 550 vdc. Pilot duty rating is 600 vac max. Meets NEMA Industrial Control Standards.

For details of the "200LS" series, write or call the MICRO SWITCH branch office or authorized distributor near you, or send for Catalog 84.

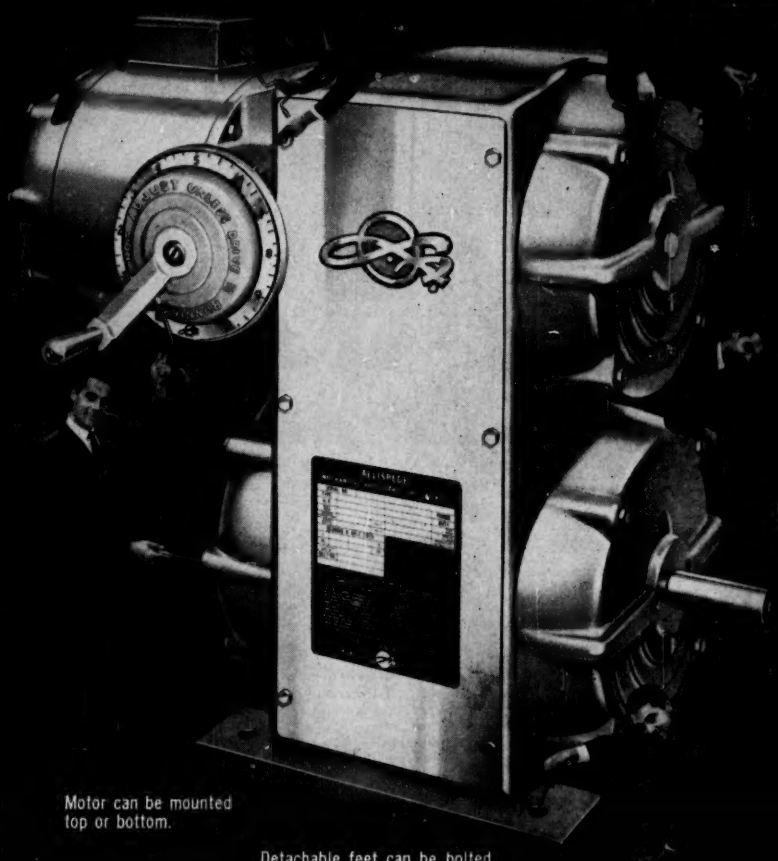
MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

Conduit box can be located top, bottom, or either side.

Control hand wheel can be positioned on top or either side.

All end-bracket assemblies are interchangeable for repositioning of drive components.



GET ALL THESE VARIATIONS FROM ONE BASIC DESIGN

— with wrench and screwdriver!

Output shaft can be high or low, right or left.

Motor can be mounted top or bottom.

Detachable feet can be bolted to bottom, side, or top for floor, wall, or ceiling mounting.

Just two of many variations that can be made from a standard ALLISPEDE DRIVE.

The ALLISPEDE* DRIVE gives you complete field versatility!

It's the most flexible and precise mechanical adjustable speed drive made . . . and the only one that can be fully adapted in the field!

The *all-new* ALLISPEDE DRIVE is the answer to any motor application that calls for low-cost adjustable speed. It permits smooth, easy speed adjustment — and maintains it exactly. Its modern design permits unusual field-flexibility — lets the user change the unit *any time* to suit his various requirements.

The a-c ALLISPEDE DRIVE is the *only* drive that can be fully adapted in the field by the user. The basic unit goes together like building-blocks . . . feet, end brackets, control hand wheel, conduit box, and output shaft can be relocated in minutes to fit existing space limitations. The same unit can be changed from an upright to a horizontal drive for floor, wall or ceiling mounting. And all you need is a wrench and screwdriver!

Superior design improves drive efficiency and extends service life. The four bearings equally distribute belt load, increasing bearing and belt life. Movable discs slide smoothly on internally-lubricated splined shafts — won't stick in place or wear. Belt changes are faster — never disturb the dial or adjustment mechanism. Rugged cast-iron housing with plated steel covers shields drive against dirt and corrosion . . . integral rotor fan cools the motor and force-ventilates the drive housing to extend bearing life. Oversize cartridge bearings are pressed on shaft and lubricated at the factory. Corrosion-resistant stainless steel nameplates diagram proper motor connection, specify bearing sizes, and carry complete instructions for operation and lubrication.

The ALLISPEDE DRIVE can be supplied with in-line or right-angle integral gears, brake and tachometer. Sizes from 1 to 20 HP with speed variations up to 8:1. Electrical and mechanical modifications are available to meet special requirements for any application.

Contact your Louis Allis District Office or Distributor for complete information and engineering assistance. Or write for Bulletin 3300, The Louis Allis Co., 447 E. Stewart Street, Milwaukee 1, Wisconsin.

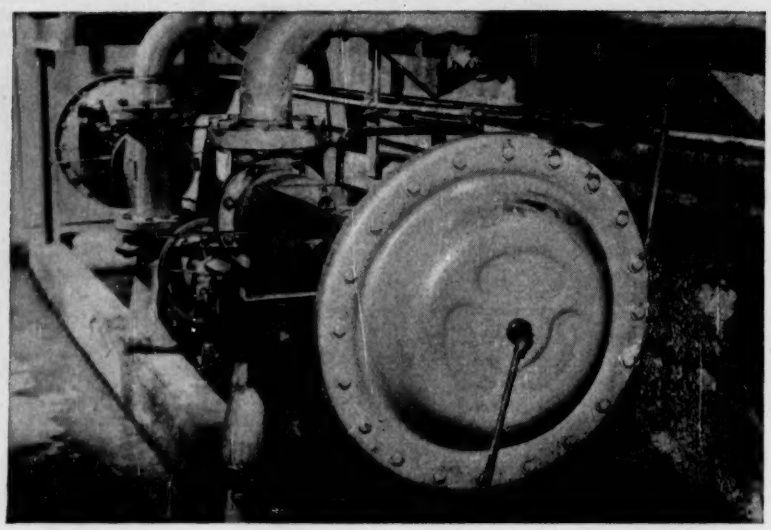
*ALLISPEDE is a trademark of The Louis Allis Co.

ASD-116

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

Found:
a valve responsive to sensitive instrument control, with low maintenance



Grinnell-Saunders Straightway Diaphragm Valves on back of Trimbey meter on Mead Corporation's No. 10 paper machine.

Grinnell-Saunders Straightway* Diaphragm Valves were originally selected by Mead Corporation for stock level control at its Chillicothe, Ohio paper making plant. Mead's instrumentation specialists wanted a valve which would provide fine control in response to sensitive instruments.

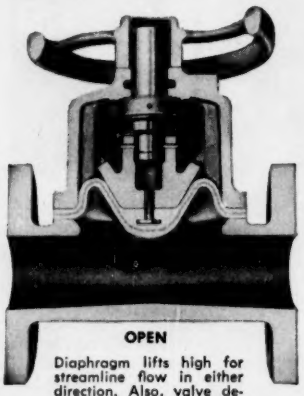
Because these Straightway Valves also avoid difficulties from clogging, stringing and dewatering as well as leakage, plugging, sticking and erosion, they have since been specified for other services throughout the plant.

Grinnell-Saunders Straightway Diaphragm Valves solve tough problems in many piping systems. They provide special benefits in lines handling corrosive fluids, viscous material, fibrous slurries, sludges, solids in suspension and semi-fluid materials.

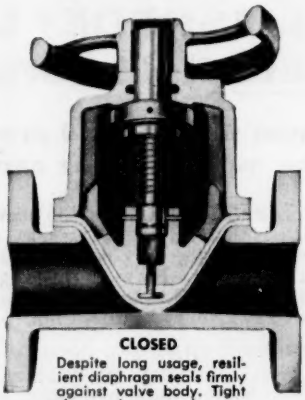
These highly efficient valves provide streamlined flow, positive closure, complete isolation of operating mechanism, minimum maintenance, interchangeability of parts, manual or power operation, and a choice of body lining and diaphragm materials.

For complete information on straightway or standard weir types, handwheel, lever, or power operated, write Grinnell Company, Inc., 277 West Exchange Street, Providence 1, Rhode Island.

*PATENTED



OPEN
Diaphragm lifts high for streamline flow in either direction. Also, valve design permits comparatively simple rodding through, when necessary.

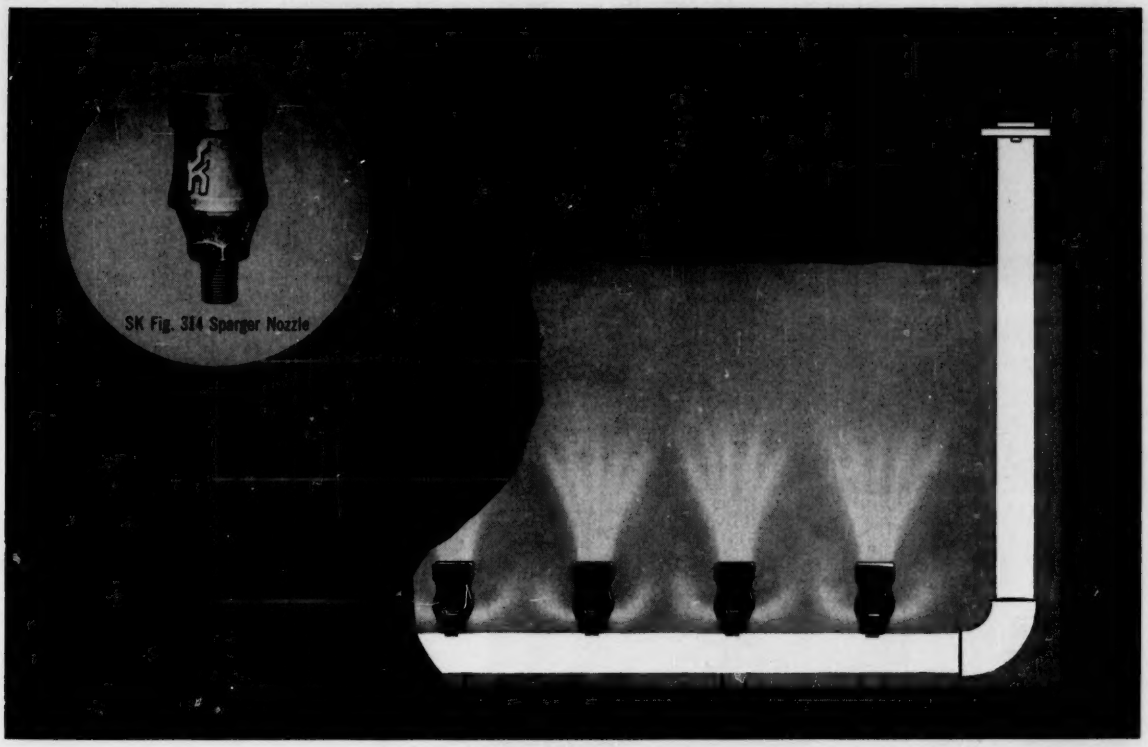


CLOSED
Despite long usage, resilient diaphragm seals firmly against valve body. Tight closure is assured, even when handling gritty or fibrous materials.

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

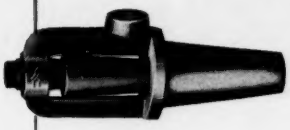
pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



HOW TO HEAT AND AGITATE LIQUIDS IN TANKS

efficiently, economically, and with less noise

SK Fig. 301 Noiseless Heater for Tank Heating



SK Fig. 315 Circulating Heater for Tank Heating

SK Fig. 320 Continuous Heater for Pipe-Line Heating

SK Fig. 327 Slurry Heater for Pipe-Line Heating

Do it with plant steam and SK Steam Jet Heaters.

These Heaters utilize the jet principle to mix steam with a cold liquid, uniformly and without the noise and vibration usually associated with such operations. Since all of the heat in the steam is absorbed by the tank liquid being heated, operation is efficient. Because the jet action of the Heaters produces agitation and circulation, you need no additional equipment to perform these functions. Furthermore, since Steam Jet Heaters have no moving parts (except an adjusting spindle on some pipe-line types), you get long, trouble-free service without costly supervision and maintenance.

The illustration above shows tank heating being accomplished using SK Sparger Nozzles—one of the several types of Heaters offered by SK. Units of this type are ideal for use where uniform agitation is required over a large shallow tank area. In operation, a jet of steam issuing through the nozzle entrains tank liquid through the suction opening. Condensation takes place immediately upon mixing of liquid and steam and the stream of heated liquid is discharged at considerable velocity providing constant agitation.

Several other types of SK Steam Jet Heaters—for both tank and pipe-line heating—are shown at left. Complete details on all types are contained in Bulletin 3A which is available on request.

JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
GEAR PUMPS: Ask for Bulletin G-1.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS SINCE 1876
2217 State Road, Cornwells Heights, Bucks County, Pa.

You'll never have to nurse this O_2 Analyzer

What are your most serious complaints about O_2 analyzers? Cumbersome? Slow? Unstable? Hard to service on the job?

You won't find these potential trouble-sources in our new Unitized O_2 Gas Analyzer. They've been literally "designed out" by L&N engineers with experience totaling millions of man-hours in industrial gas analysis.

The Unitized O_2 Analyzer is reduced to the essentials consistent with highly efficient O_2 measurement and control. The entire analysis is made within the 2-component team of O_2 Analyzer Assembly and Speedomax® recorder, eliminating unwieldy auxiliary components such as sample conditioners. Due to its direct magnetic operation, the equipment employs neither auxiliary gas supplies, chemical reactions, nor combustion. Sample and calibration controls are accessible externally, without disturbing the measuring system.

We've introduced sampling innovations, too. The Analyzer gets a sample not only cleaned but purified. A typical sampling lag is 1 sec per 45 ft of ¼" tubing, up to several hundred feet.

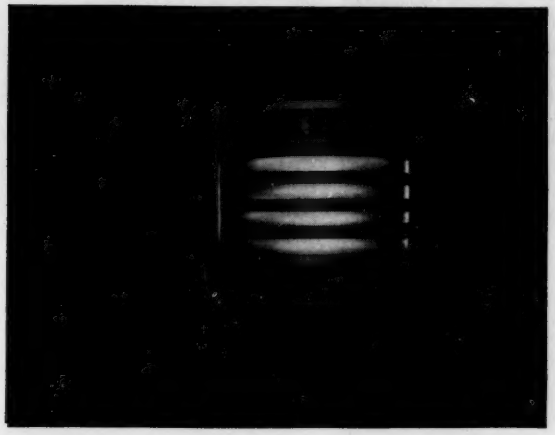
The Unitized O_2 Analyzer can help to streamline O_2-dependent processes. For pertinent details of this O_2 monitor, write to 4916 Stenton Ave., Phila. 44, Pa., for Folder ND46-91(5).

PERFORMANCE

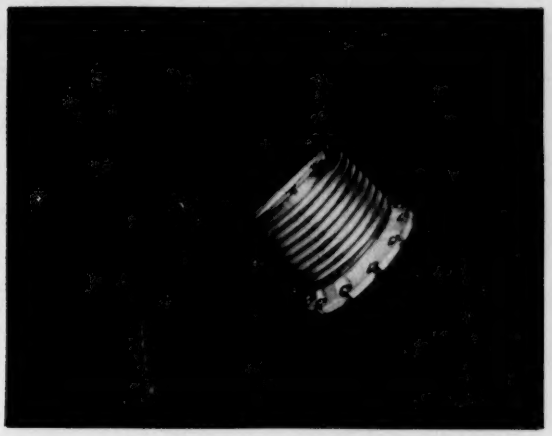
Range	*0 to 5% O_2, 0 to 10% O_2, or higher in flue gas or N_2 as specified.*
Accuracy	*0.15% O_2*
Sensitivity	*Better than ±0.05% O_2*
Stability	*Better than ±0.15% O_2*
Response	*4 sec for initial response; 40 sec for 90% response.*

LEEDS *instruments* **NORTHRUP** *automatic controls • furnaces*

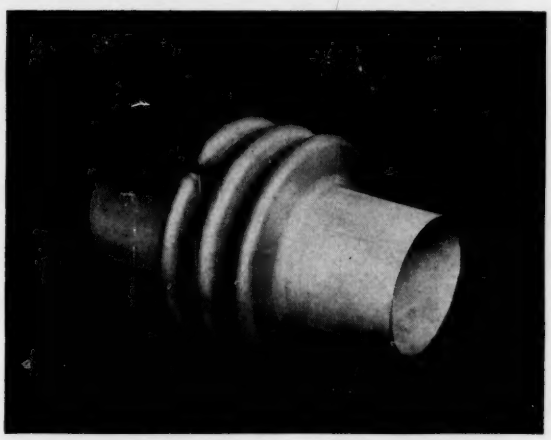
4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.



3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea *for maximum reliability*

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

This propane tank wall shrinks... but free-standing **FOAMGLAS®** solves the insulation problem

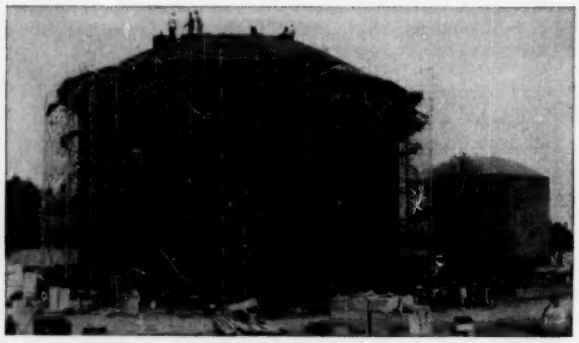
The strength of FOAMGLAS solved an unusual insulation problem posed by contracting tank walls in the nation's first refrigerated propane storage plant. Designed and built by Stone & Webster Engineering Corp., for the Atlanta Gas Light Company, the storage facilities at Riverdale, Georgia, consist of three steel tanks. Each is 70 ft. in diameter and 52 ft. high with a capacity of 1,297,500 gallons of refrigerated propane.

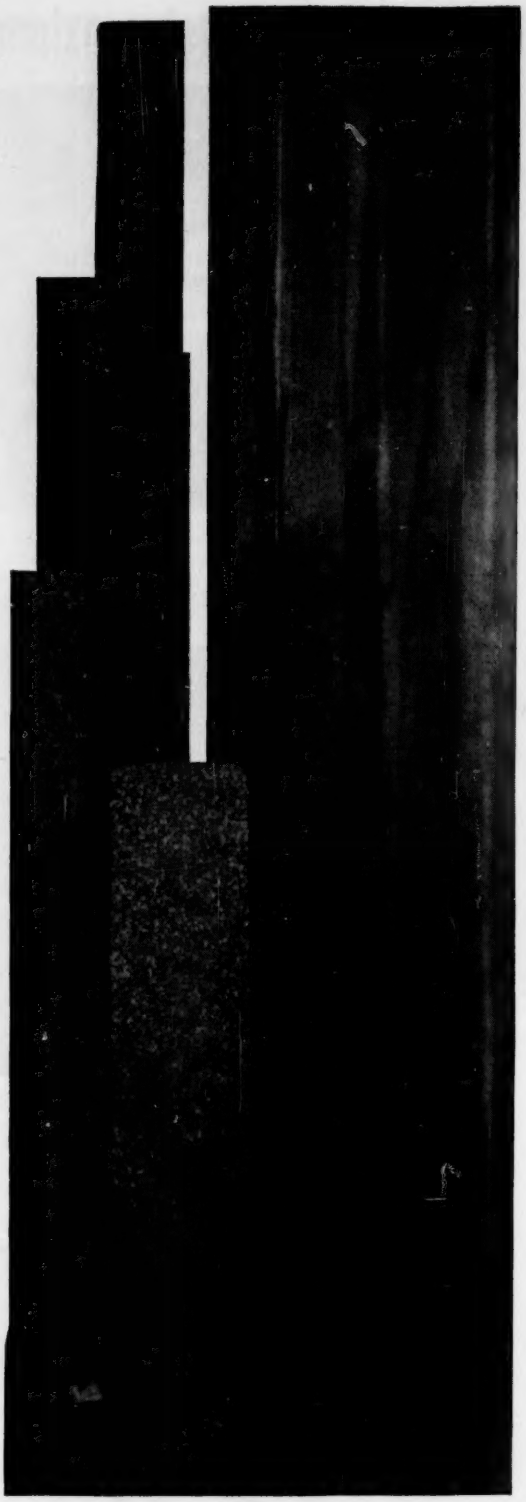
When the tanks are pulled down to an operating temperature of —46°F., their walls contract. Ordinary insulations—applied in direct contact with the tank walls —just won't work. But the unique strength of FOAMGLAS permits its use as a free standing wall of insulation . . . self-supporting and separated from the tank walls by an air space. The same high compressive strength permitted placing FOAMGLAS beneath the tank floors as well as on the tank roofs.

Insulating performance? FOAMGLAS is completely moisture-proof to insure constant high insulating value for the life of the tanks . . . prevent condensation or freezing of moisture between insulation and tank walls. And since FOAMGLAS can't absorb volatile hydrocarbons, it never becomes a fire hazard.

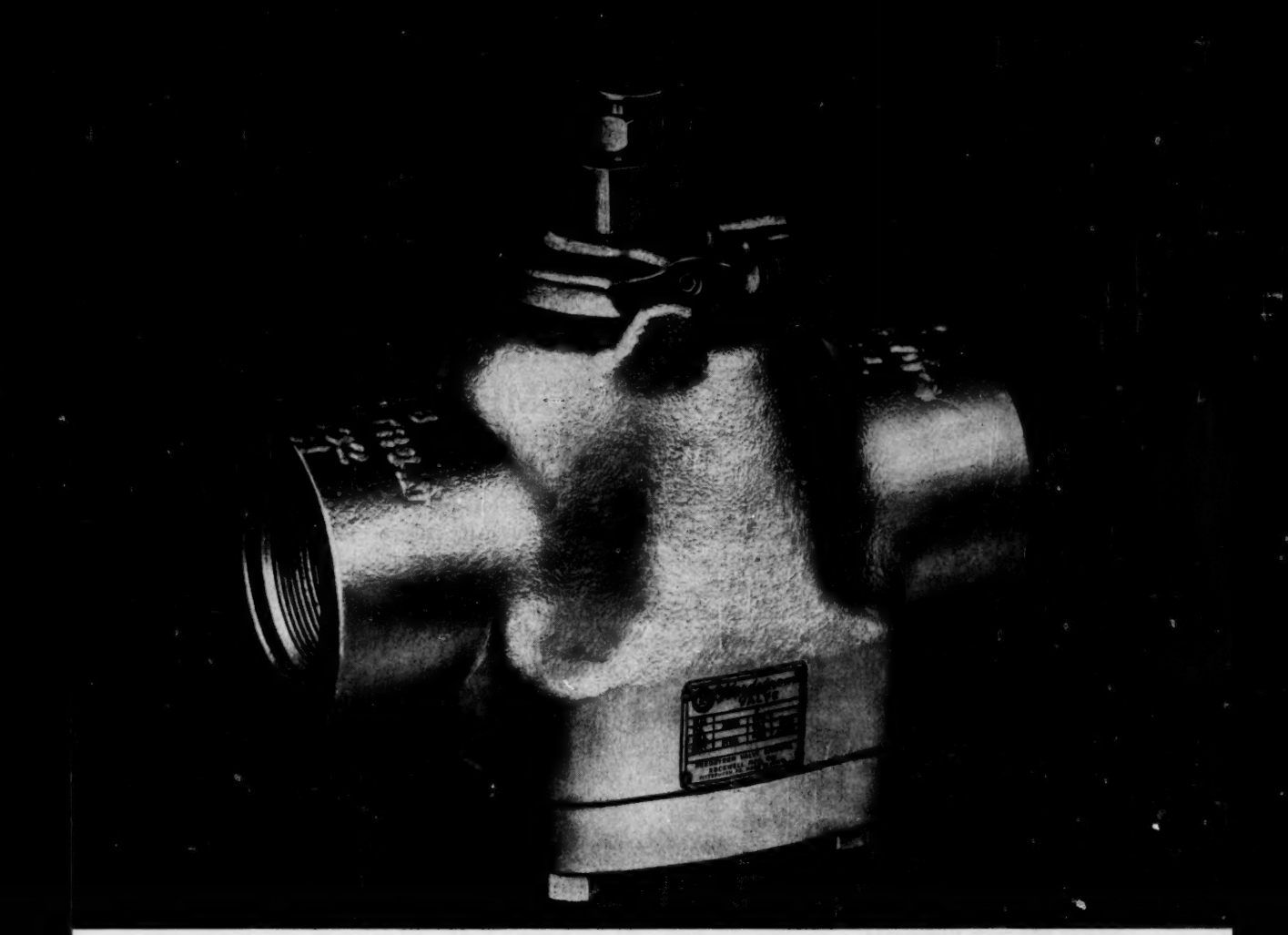
Check the unique combination of benefits offered only by FOAMGLAS. Write Pittsburgh Corning Corporation, Dept. H-79, One Gateway Center, Pittsburgh 22, Pa. In Canada: 3333 Cavendish Blvd., Montreal, Quebec.

Pittsburgh Corning offers a complete line of mastics, tank coatings and other accessory materials specifically designed for use with FOAMGLAS.

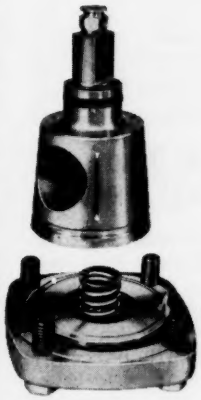




PITTSBURGH PC CORNING



NEW Rockwell-Nordstrom Steel 1000-lb. Round Opening Valve . . .



Spring seated plug has full round opening. "O" rings seal to atmosphere and Sealdport® lubricant grooves stop leakage of lightest gases or heaviest fluids.

The new Rockwell-Nordstrom 1000-lb. inverted plug valve is designed to give valve users all the *proven* benefits of lubricated plug valves, plus the advantage of a full round opening in smaller size valves. Here are just a few of the advantages of the new inverted plug valve:

1. LOW TORQUE: "O" rings replace conventional packing gland . . . plug is lubricated for easy turning . . . rugged spring maintains perfect seating.

2. FULL ROUND OPENING: No cavities . . . minimum pressure drop . . . easy access for scraping.

3. SIMPLE, RUGGED DESIGN: Compact dimensions save space, fewer parts mean fewer repairs.

Rockwell-Nordstrom 1000-lb. round opening valves are now available in 2" x 2 1/16" size with API line pipe thread for production, pipeline, refinery, marketing, marine and process services; and with external upset threads for Christmas Tree services. Also available in 2" size with flanged ends (300-lb., 600-lb. class). For complete details, see your supplier or send the coupon below. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

Lubrication makes the difference

ROCKWELL-Nordstrom VALVES
another fine product by
ROCKWELL

SEND COUPON FOR COMPLETE DETAILS

Rockwell Manufacturing Company
Pittsburgh 8, Pa.

☐ Please send Bulletin V-611 on the new Rockwell-Nordstrom inverted lubricated plug valve.

☐ Please have a Rockwell Field Engineer call me for an appointment.

Name_____ Title_____

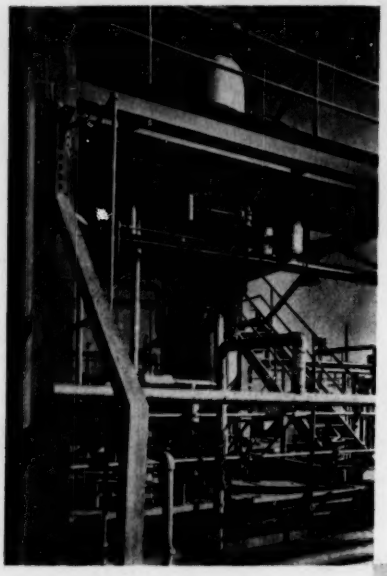
Company_____ Address_____

City_____ Zone____ State____

RODNEY HUNT

FLUID PROCESSING

RODNEY HUNT MACHINE CO., Process Equipment Division, 31 VALE STREET, ORANGE, MASS.

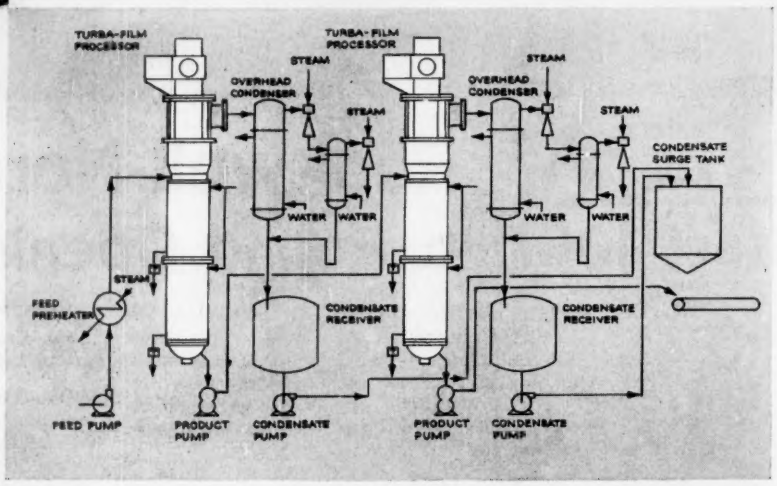


RODNEY HUNT PROCESSORS SOLVE COMPLEX PROBLEMS IN VARIED APPLICATIONS

Rodney Hunt Turba-Film Processors and Vacu-Film Processors have proven to be extremely versatile not only in the range of industries and products they serve, but also in the different kinds of processes they perform. The units assure closely controlled uniformity of product in processes such as – desolventization...concentration...deaeration...distillation...steam distillation ...deodorization...liquisolids...and homogenization. The flow chart below illustrates a typical DESOLVENTIZATION wherein the Turba-Film Processors successfully desolventize a plastic or resin solution. When a product is required virtually free of carrier solvent, the viscosity may increase greatly while the last traces of solvent are removed. In the plastics industry, desolventized liquids with viscosities of 10,000, 50,000, or 100,000 centipoises create no problem for the Turba-Film Processor.

Turba-Film Processors Free Epoxy Resins of Volatile Non-resin Compounds

In plastics, epoxy resins find increasing use in many new applications. These resins must be free of volatile non-resin compounds. Major producers of epoxy resins are meeting this requirement with Turba-Film Processors. Higher efficiency and greater throughput than possible with conventional equipment is realized with Rodney Hunt Processors. In addition, product color is superior due to the absence of localized overheating.



FILL IN COUPON FOR MORE INFORMATION ABOUT RODNEY HUNT PROCESSING EQUIPMENT

Please send me the bulletins checked.

- ☐ THE TURBA-FILM PROCESSOR
- ☐ THE VACU-FILM PROCESSOR
- ☐ THE LABORATORY VACU-FILM PROCESSOR

Name.....

Title.....

Company.....

Address.....

Mail to: Rodney Hunt Machine Co., Process Equipment Division, 31 Vale Street, Orange, Mass.

RODNEY HUNT OPENS NEW YORK SALES OFFICE

"Since 1840..." is a phrase that frequently appears in Rodney Hunt literature and advertising, for that was the year in which the company was founded. By sheer coincidence, the new office Rodney Hunt recently opened in New York City to better serve customers in the metropolitan area is Room 1840 of the Lincoln Building. Located at 60 East 42nd St., the telephone number is YUkon 6-8494.

DEVELOPMENTS . . .

JULY 13, 1959

Chementator

C. H. CHILTON

Union Carbide has developed a tank truck for interplant transport of liquid ethylene, a chemical not usually carried in bulk. Special truck hauls 30,000 lb. per load.

Despite economic failure so far in U. S. and Great Britain, underground coal gasification is headed for the big time in Russia. First of six large gasification stations, now nearing completion, will produce over 80 billion cu. ft./yr.

No radically new hydrocarbon chain reactions are induced by radiation, reports Esso. This means that, lacking unique effects, radiation must compete with other, more common process tools. Most promise: where high selectivities are needed.

Silicone rubbers get firm foothold

A group of new silicone rubbers introduced last month by Dow Corning have unusual firmness and density. Silicone elastomers until now have been identified with softness and stickiness and could not be handled on equipment used for conventional rubbers, without special techniques. New properties result from elimination of low molecular weight fraction and use of an additive.

Most eye-catching of the group is a fluorinated silicone, LS-63, that stands up to the exotic fluids and high heats of the jet age. Blood brother to DC's three-year-old fluorinated silicone LS-53 (with whom it shares this ability for punishment), it differs in that it's pigmentable and can be worked on conventional rubber-fabricating equipment. LS-53 must be pigmented red, can only be molded.

Both fluorinated products sell for $16/lb. in 1,000-lb. quantities. This is slightly higher than rubbers making similar performance claims—Du Pont's fluorinated hydrocarbon, Viton, and GE's nitrile silicones. But Dow Corning feels its products at least equal these competitive ones in fluid and heat resistance while excelling them in low-temperature properties.

Five of the new Dow Corning silicones are completely compounded materials. In addition to LS-63, two are for general-purpose use, two are for wire and cable insulation.

New rule limits olefins in gasoline

Another onerous air pollution ruling affecting petroleum refiners in the Los Angeles area was adopted by the County Board of Supervisors last month and went into effect June 30.

Rule 63 limits the olefin content of gasoline sold in the county to 18%. It also aims to lower this limit to 12½% by Jan. 1, 1962. But

New

The latest refinement in a long-tested, proved and improved explosion-proof combination Motor Starter & Circuit Breaker, this new Crouse-Hinds Condulet® EPC-M59 brings you tomorrow's convenience, dependability and safety at yesterday's prices.

Designed to conform with the National Electrical Code requirements for Class I, Groups C and D; Class II, Groups E, F and G; and Class III, it provides for built-in breathers and drains . . . built-in push-button stations, selector switch and pilot lights . . . seven taper-tapped conduit entrances . . . starter below breaker for safe, easy maintenance . . . compact design to permit a greater number of controls in any given area.

Now available in 7" and 9" sizes for Sizes 1 and 2 starter combinations. For more detailed information consult your Crouse-Hinds distributor, or any of the offices listed below.

ALL THESE NEW FEATURES

1 NEW raintight joints for both top and bottom covers

2 NEW shoes and guidance slot for easier interior assembly mounting

3 NEW built-in pilot lights available where visual indication desired

4 NEW easier-to-lock breaker handle (takes up to 3 padlocks)

5 NEW center section (and covers) of lightweight aluminum

6 NEW notched covers loosen quickly with pinchbar or screwdriver

7 NEW larger internal space for wiring ease

8 NEW replaceable 3-hole bracket makes mounting quick, easy

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.
Crouse-Hinds Instrument Company, Inc., Silver Spring, Maryland

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING
• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Atlanta Boston Baton Rouge Birmingham Boston Buffalo Charlotte Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. St. Louis St. Paul Salt Lake City San Francisco Seattle Tulsa Washington
Resident Representatives: Albany Baltimore Reading, Pa. Richmond, Va.

it would be subject to change on the basis of future findings.

Refiners did not fight this rule with the same verve they put into opposing Rule 62, adopted last November, which slapped a 0.5% limit on sulfur content of fuel oil (*Chementator*, Dec. 15, p. 65). A spokesman for Western Oil & Gas Association states philosophically, "We are certain that Rule 63 will be completely unnecessary in the event a successful device which will burn automobile exhaust is developed. We do not believe sufficient research work has been done to establish the correct level of olefin content, particularly the lower level specified as the eventual target."

Apparently refiners can meet the 18% figure today without trouble. (Gasoline sold in the area now averages about 15%.) And they're betting that the more restrictive 12½% limit will never be needed.

W. L. Faith, managing director of Air Pollution Foundation, has spoken out plainly on this subject. He terms this kind of regulation "nonsensical." "There is no pat relationship between the gasoline poured into an auto tank and the exhaust that comes out the tailpipe," he says. "We have learned that olefins can show up in the exhaust even when olefin-free gasoline is used."

An APF research project at Stanford Research Institute last year indicated that olefin-free gasolines produced just as much eye-irritation potential as gasolines now on the market in Los Angeles. Smog-forming tendency of engine exhaust was found to correlate with mechanical condition of the engine rather than with fuel composition.

Uranium cloud has gold lining

Uranium producers outside the U. S., facing possible loss of their markets after contracts with AEC expire, are hoping to cut costs via major advances in technology and thereby remain competitive.

Pressure leaching of ore is one idea getting serious study in Canada and South Africa. The South African Chamber of Mines—a private combine of gold and uranium producers—has a 1-ton/day pilot plant at Johannesburg. The chamber is now poring over plans drawn up by Chemical Construction Corp. for a proposed 500-ton/day demonstration plant.

The new plant would adapt to uranium processing the type of hydrometallurgy applied heretofore on a limited basis to cobalt, nickel and copper (*Chem. Eng.*, Jan. 27, 1958, pp. 112-114). The ground ore would be slurried in water and blown with air in a vertical autoclave at about 200 psi. The natural sulfide content of the ore would oxidize to form sulfuric acid and heat, nicely furnishing the right conditions for dissolving the ore's uranium.

Chemico cites these advantages:

- No sulfuric acid is needed for leaching, eliminating this element of cost.
- Smaller equipment and continuous operation promise lower labor costs.
- Normal uranium yield of 80-83% is expected to soar to well over 90%.

Especially intriguing to the South Africans is the prospect of pocketing more gold by reversing the usual sequence in which gold tailings are processed for uranium. By first pressure-leaching the virgin ore for uranium, the mineral structure of the gangue is made more amenable to gold recovery.

On the negative side is the higher first cost of leaching equipment as well as uranium's cloudy future market picture.

Cryogenic route to pure hydrogen

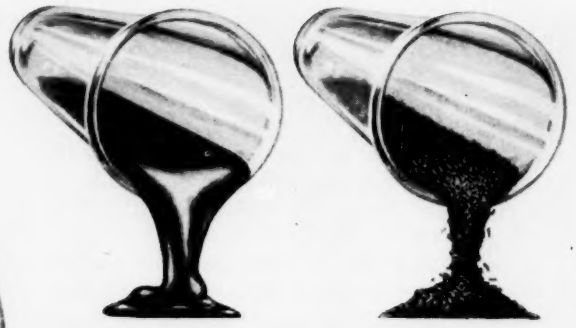
Hydrogen producers, distributors and users are eyeing with interest a small Bayway, N. J., plant turning out high-purity hydrogen from refinery offgas (Esso's) at a price competitive with electrolytic hydrogen.

Van de Mark Chemical uses indirect cooling with liquid nitrogen—rather than the usual absorption—to condense out impurities in the feed. Resulting product: better than 99.99% hydrogen, with less than 75 ppm. hydrocarbons and less than 10 ppm. CO. This hydrogen, says distributor Linde, is as good as, if not superior to, electrolytic hydrogen—long the standard in commercial hydrogen purity.

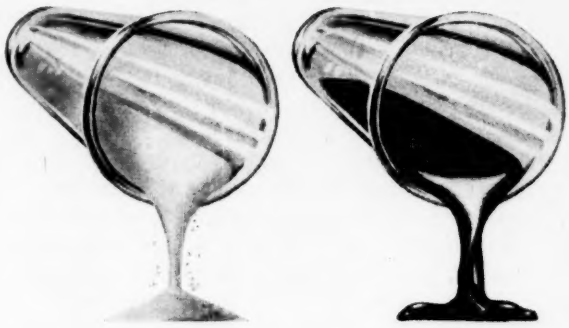
Van de Mark can produce 15 million std. cu. ft./mo. in a plant valued at only $200,000-$250,000. This is a modest investment for a business whose economics usually prescribe capacities of 50-200 million cu. ft./mo.

Hydrogen feed at 150 atm. passes through a battery of ¼-in. tubes bathed in liquid nitrogen at −300 F. The heat exchanger's special design affords not only high heat-transfer rates (U=500) but also the close temperature control needed to keep condensed impurities from freezing before removal from the system.

(Continued on page 72)



WORLDS OF BLENDING



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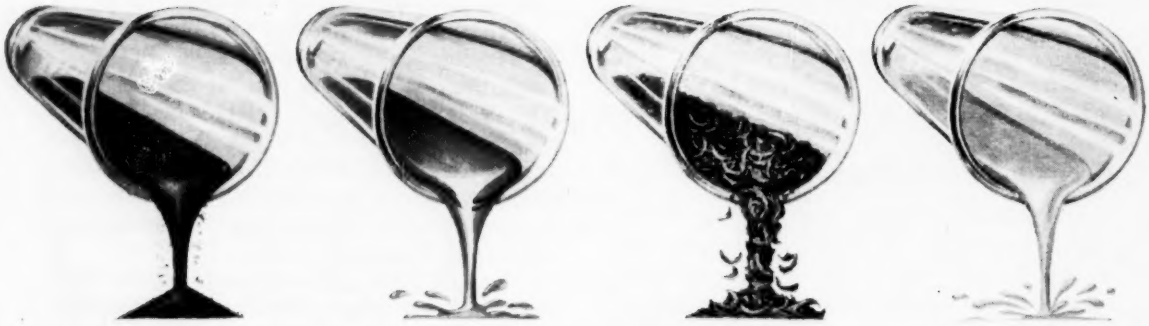


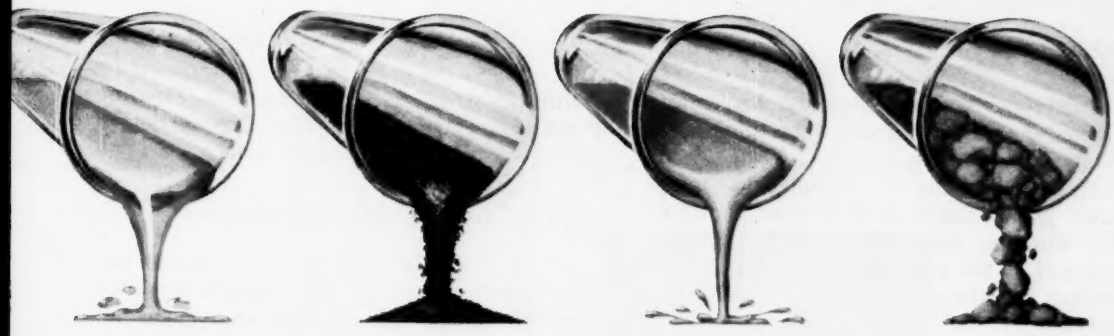
IN PRODUCTION QUANTITIES. A new centrifugal force Liquid-Solids blender has evolved from P-K's exclusive "Twin-Shell" design. It blends never-before-practical combinations of liquids and solids! It reduces conventional blending operations to a single step!

For new combinations of liquids and solids, this amazing blender offers untold advantages. Applications are limited only by imagination. They range from chemical reactions to coating very light solids such as cork, to producing all types of controlled granulations from fine to coarse.

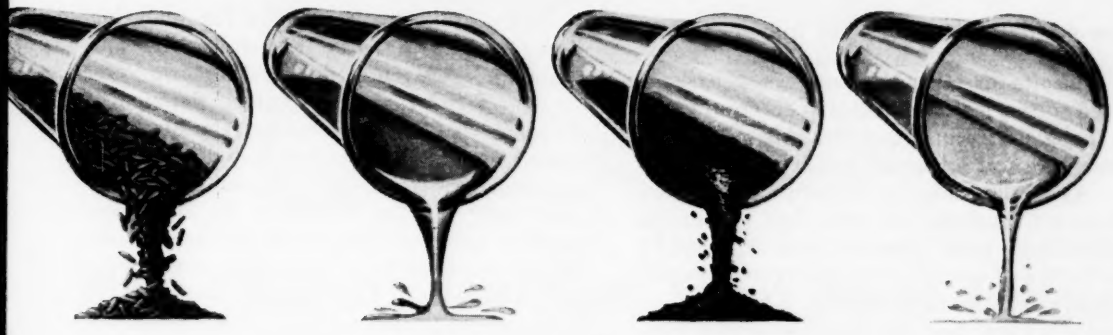
In conventional applications, the one-step P-K Liquid-Solids blender often eliminates two and three separate stages of blending, pulverizing and screening. It replaces a multiplicity of equipment. It reduces equipment investment and materials handling costs.

P-K Liquid-Solids units blend up to 40% liquids by weight. Blending requires minutes, not hours. It involves four simple actions: 1) Dry Solids are charged to about 65% of shell volume. 2) Solids are tumbled and aerated to break up agglomerates. 3) Atomized liquid is dispersed through patented centrifugal force spray discs. 4) Product is discharged from the bottom of the blender.

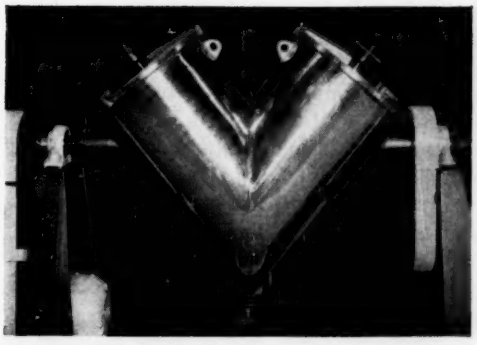
All surfaces of the blender are freely accessible. The



POSSIBILITIES



LIQUID WITH ANY SOLID!



Liquid-Feed bar is easily removed. These features speed cleaning and safeguard against contamination. Sizes range from laboratory models to 50 cu. ft. capacity.

FREE PRE-TEST OFFER. You can preview blending economies at our Laboratory. Pre-testing predicts savings in processing and handling and realistically demonstrates the unique performance of this blender.

Our pre-test facilities for blenders – and also for P-K Vacuum Tumble Dryers – are at your disposal. Send or bring your test materials. For complete information call (Stroudsburg – Hamilton 1-7500) or write George Sweitzer at our East Stroudsburg Headquarters, 1507 Hanson Street. 15

Patterson Kelley

Chemical and Process Equipment Division, East Stroudsburg, Pennsylvania

Adsorbent beds of molecular sieves and activated carbon help remove water and hydrocarbons along the way.

Heat leak—bane of any small low-temperature plant—has been held down to 1,200-2,000 Btu./hr. Temperature differential at warm end of the exchangers (where product hydrogen transfers its "coolth" to feed) is a stingy 5 F.

Van de Mark seeks wholesale hydrogen business and will build and operate a plant at point of use. However, if you want your own plant, you can contact the process designer, Chemical Design, Inc., Lewiston, N. Y.

Low-grade sulfur ores get big play

Despite an abundant supply of Frasch-mined sulfur, local economics in different parts of the globe focus attention this month on development of low-grade sulfur ores.

At Sulphurdale, in western Utah, Dixon Western Chemicals will soon start building a multimillion-dollar chemical complex based on production of sulfuric acid from conglomerate sulfur rock. And in Argentina, Chemical Construction Corp. has just commissioned a commercial plant for extracting 99.5% sulfur from another low-grade ore.

Both projects are patterned after earlier plants which pioneered the two processes. Selection of these processes the second time implies that they are economically as well as technically sound.

First plant of the Dixon type has been operated for some four years by Anaconda at Yerington, Nev. (see Process Flowsheet, Aug. 1955, pp. 288-291). Crushed ore, containing 25-30% sulfur, is roasted in Dorr FluoSolids reactors to produce a stream of 12% SO_2 for manufacture of 450 tons/day of acid.

Dixon plans to make 500 tons/day of acid from a deposit of similar ore. Future plans call for production of several hundred tons per day of hydrofluoric acid, using large deposits of nearby fluorspar. Dixon Western is a joint affiliate of Dixon Chemical & Research Corp. and American Sulphur & Refining Co.

The Argentine plant recovers 50 tons/day of sulfur from 208 tons of ore via a process proved out in a similar plant in Colombia. Chemico, who built both plants, hopes to establish this technology in the U. S.

Finely ground ore pulp is heated in an autoclave to melt the sulfur, then quickly quenched, while being stirred, to freeze the sulfur in globules large enough to separate from the gangue by screening. Process details will be described in an early issue.

Get set for the union organizers

Ten AFL-CIO industrial unions—including the two chemical unions—met in Washington last month to map long-range plans for organizing the nation's white-collar workers.

Engineers are high on the unions' list of strategic objectives. As evidence:

- AFL-CIO will set up a special program to teach organizers how to win professional and technical people.
- Another program calls for analyzing contracts covering professional workers and studying legislation affecting these workers.

One trend behind the unions' decision to woo engineers is the increasing ratio of white-collar to production workers in today's highly mechanized and instrumented plants. It makes good logic for the unions to go after new markets for their services in the face of declining revenues from blue-collar workers.

Some of you may actually welcome the union; a recent survey indicated that one out of five engineers favors collective bargaining. For the rest of you, *CE's* You & Your Job department recently published an article (May 18, pp. 190-192) telling you what to do when the organizer comes.

And addressing itself to the front office, National Association of Manufacturers recently reported: "Salaried employees are becoming more and more concerned about their own problems, and recent developments have tended to undermine their traditional willingness to rely on management. . . . There is a crucial need for management to recognize this problem, to put its house in order, and to undertake constructive programs to cultivate salaried employee loyalty."

Tomorrow's Technology

Today's embryonic developments which have special significance for chemical engineers

Aluminum makers eye SiC linings

Silicon carbide's ability to lose heat—and thereby keep itself relatively cool—is attracting attention throughout the aluminum in-

"I'm interested in boron trifluoride because it's an easy catalyst to work with" . . . Plant Superintendent

"I'm most interested in the high reactivity of boron trifluoride" . . . Research Director

"I've discovered that by using BF_3 we can simplify our plant designs" . . . Chief Engineer

What interests you most about Boron Trifluoride?

Whatever your reasons for investigating boron trifluoride, you'll find Baker & Adamson® is your best source of information. B&A has long been the leader in BF_3 research and production. B&A was the first to introduce boron fluoride etherate to industry . . . has shipped boron fluoride gas by tube trailer transport for many years—making it readily available in large commercial quantities. Today, B&A offers the widest range of BF_3 complexes, including ether, phenol, monoethylamine, other nitrogen and oxygen compounds. That's why—when it comes to BF_3 call on Baker & Adamson.

Useful product data bulletins

B&A has compiled extensive reference data on the use of boron fluoride gas and its complexes as efficient catalysts in organic synthesis. Boron fluoride's wide range of applications and its cost-cutting production advantages—such as its ease of catalyst removal—make it a factor to be considered in almost any organic synthesis problem. Write today for any or all of the free technical bulletins listed below:

TITLE	CODE No.
Boron Trifluoride, Compressed Gas	DA-34691
Boron Trifluoride, Compressed Gas Handling Information	TB-34691
Boron Fluoride Complexes with Nitrogenous Compounds	DA-3469-NIT-1
Boron Fluoride Complexes with Oxygen-Containing Compounds	DA-3469-OXY-1
Boron Trifluoride, Ether Complex, Tech.	DA-34711
Boron Trifluoride, Monoethylamine Complex, Tech.	DA-34661
Boron Trifluoride, Phenol Complex, Tech.	DA-34681

New book on Boron Fluoride

The most extensive study of boron fluoride to date is contained in a new book, "Boron Fluoride and its compounds as catalysts in organic chemistry," written by A. V. Topchiev, S. V. Zavgorodnii and Y. M. Paushkin. It discusses the use of boron fluoride as a catalyst in organic chemistry and also its derivatives and molecular compounds. Contents include physical and chemical properties; co-ordination compounds; compounds of boron fluoride in alkylation, polymerization, isomerization, cyclization, nitration and sulphonation reactions; condensation reactions in the presence of boron fluoride; and many other topics.

This book (price, $12) is published by Pergamon Press, Inc., 122 East 55th St., New York 22, N. Y.

BAKER & ADAMSON® Fine Chemicals

Allied Chemical

GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N. Y.

dustry. At least five primary aluminum producers are now testing bonded silicon carbide cell linings.

Conventional electrolytic reduction cells are lined with 8 to 13 in. of carbon. It is proposed to substitute 3½ to 4½ in. of silicon carbide for the sidewalls of the cell, leaving the carbon bottom, which serves as cathode, unchanged. Carborundum Co. engineers cite these potential advantages:

- With the same outside dimensions, a given reduction cell can produce aluminum at a faster rate. The larger cell cavity will permit use of bigger anodes, and greater heat loss through the lining will facilitate use of higher amperages without overheating the cell.
- Higher thermal conductivity of the lining, plus the increased mass of metal and cryolite bath in the cell, smooth out temperature fluctuations and give greater thermal stability.
- Higher electrical resistivity, compared with carbon, cuts down on power loss through the lining.
- Because of the sharp temperature drop across the SiC lining, a protective layer of frozen cryolite will usually form on the wall and thereby promote long wall life.

Under fluctuating conditions, however, certain areas of the lining may be bathed by molten cryolite. Ordinary ceramic-bonded SiC doesn't stand up to this very well.

Carborundum's trump card is its recently developed nitride-bonded SiC refractory (*Chem. Eng.*, Aug. 1957, pp. 172-174). This material shows much better resistance to molten cryolite.

What about the lower power efficiency due to increased heat loss through the cell walls? Carborundum thinks that longer cell life and greater capacity are overriding cost factors. But Kaiser Aluminum, commenting on economics, sees cost of the SiC itself as the biggest obstacle today.

New material: irradiated wood

Soft woods may be converted into the equivalent of hard woods by gamma radiation, reports Ray McBrian, director of research for Denver & Rio Grande Western Railroad, Denver, Colo.

Preliminary studies by McBrian's research staff indicate that addition of chemicals to soft woods, followed by gamma irradiation, will induce crosslinking or polymerization within the wood. The Rio Grande's objective: cheaper crossties. Instead of fir and oak, the road could use soft pine, suitably treated with chemicals and radiation.

McBrian states that they have actually irradiated creosoted ties and thereby obtained deeper penetration of the creosote. He also suggests that radiation might improve the seasoning of green woods.

The Rio Grande has been investigating the effects of radiation on coal and oil for several years. One promising lead is the discovery that gamma rays can shatter 200-mesh coal particles into particles of 0.5-1.0 microns (*Chementator*, June 1957, p. 142). The railroad has successfully run an experimental diesel engine with oil containing up to 10% of the fine-particle-size coal. Another discovery is that irradiated low-quality fuel oils (containing sulfur, vanadium, etc.) perform as well as high-quality more expensive fuels in internal combustion engines.

Another research program for improving the properties of wood has just been started at Battelle Memorial Institute under the sponsorship of seven major companies. Chemical crosslinking is being given serious consideration. Object is greater dimensional stability of wood without adding appreciably to its weight or cost.

Research and development briefs

Higher aliphatic alcohols can be made by liquid-phase oxidation of paraffins in the presence of boric acid, according to a Russian report to the World Petroleum Congress. Oxidation with 3.0-4.5% oxygen in nitrogen at 165-170 C. results mainly in formation of secondary alcohols having the same number of carbon atoms as the starting paraffin.

Most powerful thermoelectric generator known has been built for the Air Force by Westinghouse. It's designed to burn propane, converting 850-F. heat directly to 100 w. of electricity with no moving parts.

A machine which can learn is now possible, says David G. Willis, Lockheed scientist who has developed a mathematical model of the human neuron or brain cell. This work could pave the way to construction of a real thinking machine, ventures Willis.

For more on DEVELOPMENTS.....76

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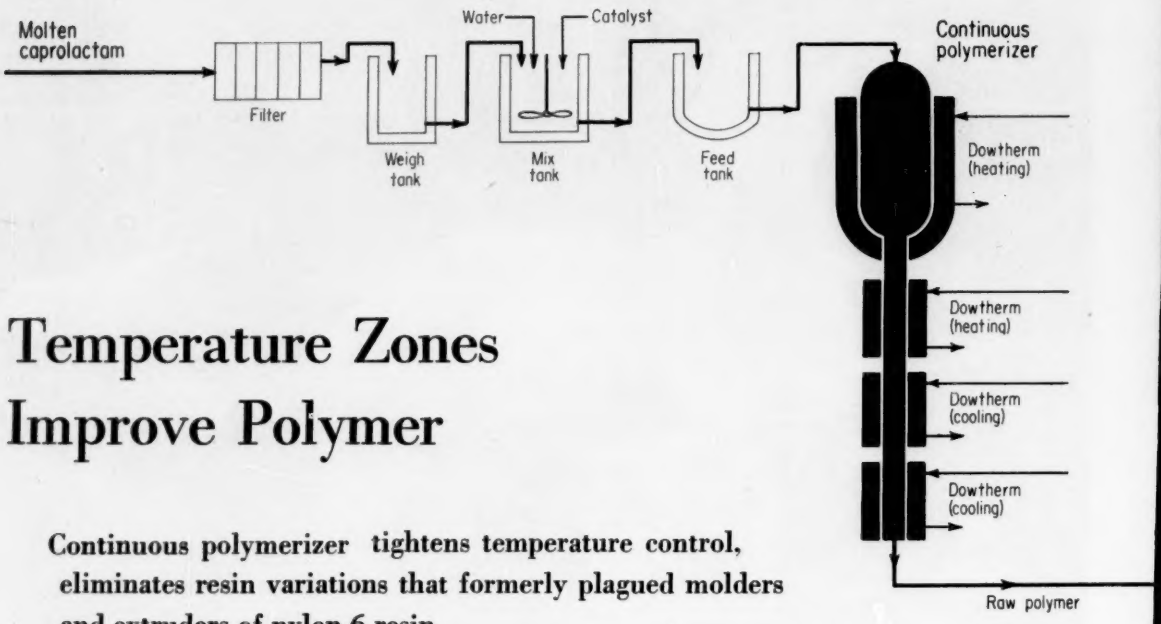


Temperature Zones Improve Polymer

Continuous polymerizer tightens temperature control, eliminates resin variations that formerly plagued molders and extruders of nylon-6 resin.

Spencer Chemical Co. reveals that its unique continuous polymerization process has virtually eliminated lot-to-lot variations in nylon-6 molding and extrusion resin.

Key to this noteworthy achievement is an unusual polymerizer configuration that permits zone control of temperature—the chief factor affecting resin properties. Engineered jointly by U. S. licensee Spencer and licensor Algemene Kunstzijde Unie (AKU), N. V., Arnheim, Holland, plant has been on stream at Henderson, Ky., since the fall of 1957.*

"In this time," remarks Plant Superintendent Carl Vincent, "we've demonstrated that we can produce material that our cutomers can rely on to exhibit the same physical characteristics month in and month out."

While granting that initial investment is greater for a continuous nylon-6 facility than for an equivalent batch plant, Spencer claims lower operating expenses to supplement improved product quality.

▶ **Open and Link**—Basically, Spencer's continuous process follows the same chemistry as does its batch cousin.

Caprolactam monomer, a cyclic ring compound, is opened by the action of heat and a catalyst to form *E*-aminocaproic acid. Then, via a polycondensation reaction, the amino acid molecules link up into a linear chain polymer—nylon 6—with evolution of heat.

Length of polymer chain is determined by type of catalyst and operating conditions. Generally speaking, the more viscous longer chain polymers serve as extrusion resins; shorter chain polymers as molding resins.

▶ **Different Hardware**—The two processes differ only in the means for accomplishing these reactions.

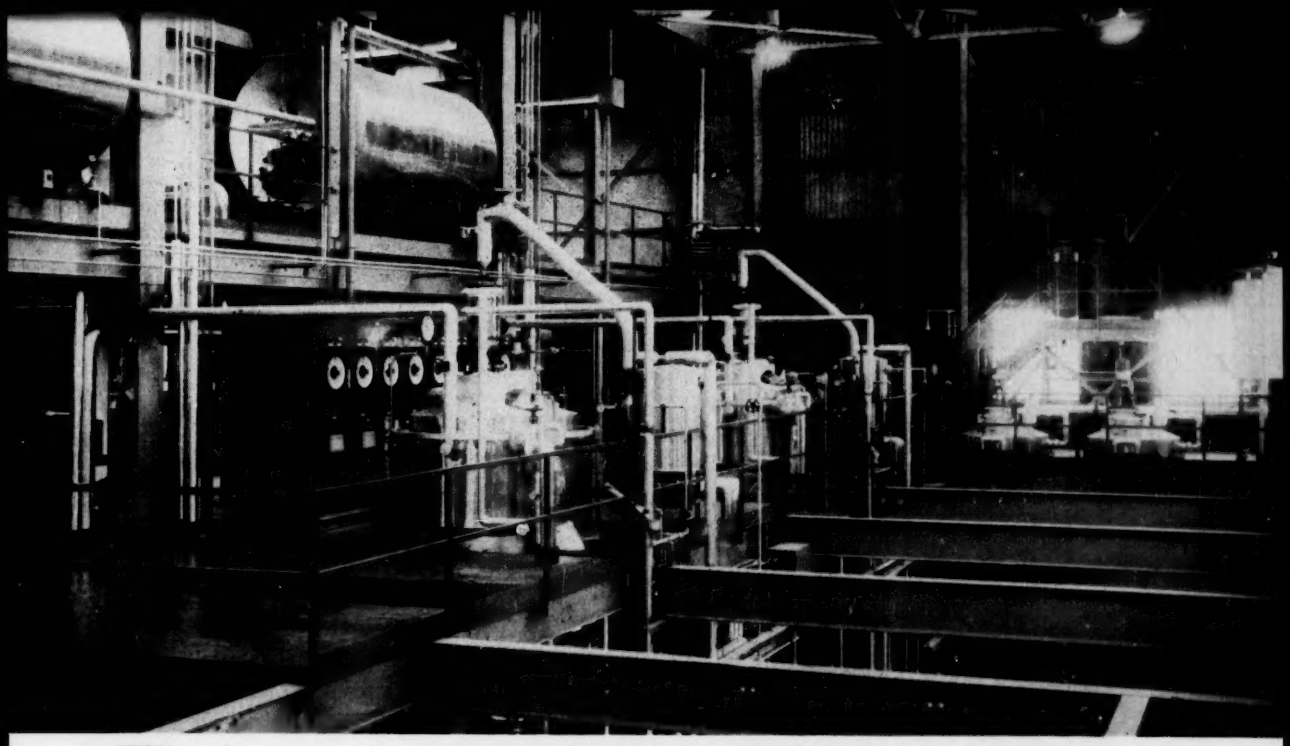
In batch process, reactions take place in sequence within same polymerizer. First, introduction of catalyst in water solution under heat and pressure opens the caprolactam ring. Then release of pressure vents water vapor which acts as a chain terminator if allowed to remain.

Polymerization proceeds to desired chain length and viscosity after release of pressure, as long as temperature is maintained at required level.

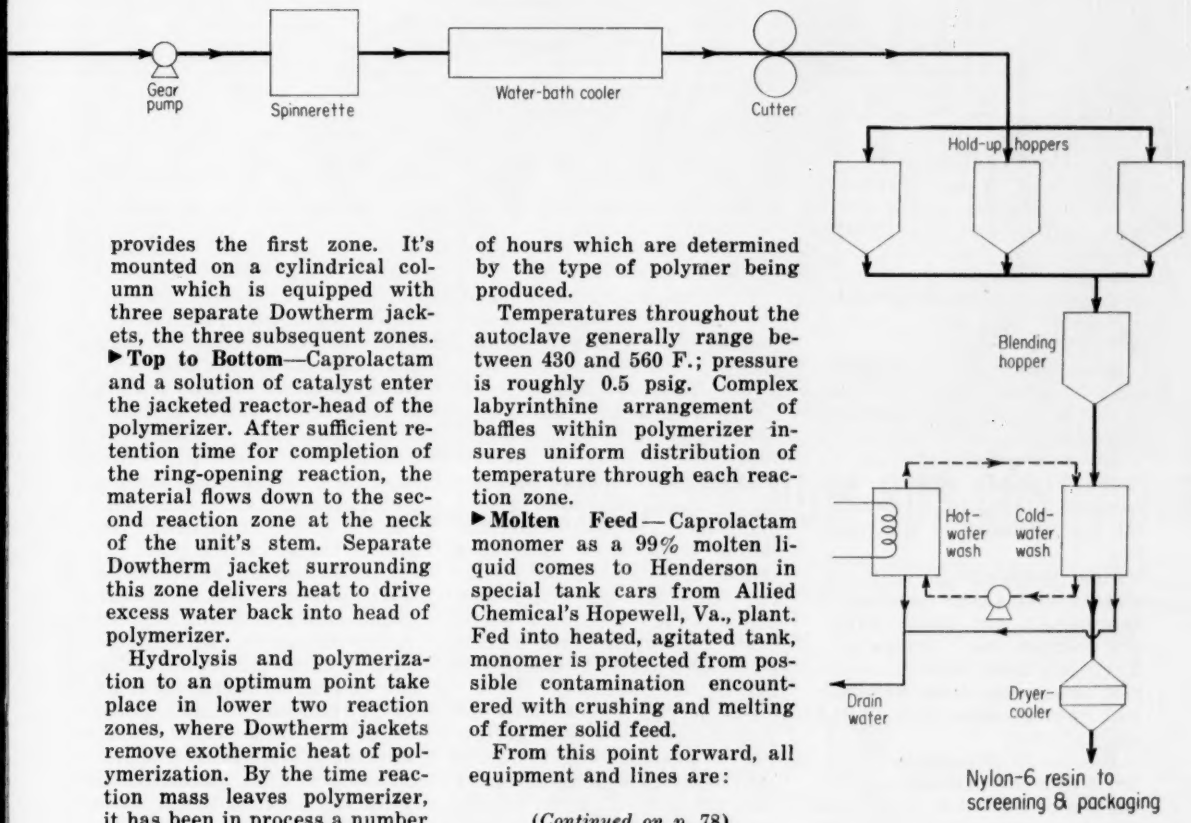
To carry out these reactions continuously, Spencer relies on four distinct reaction-temperature zones in single vertical polymerization unit.

A Dowtherm-jacketed reactor —marking the head of unit—

*Spencer's license applies only to manufacture of molding resins. AKU's American subsidiary, American Enka, operates a variation of the process to manufacture nylon 6 staple fiber and monofilament.



TWIN continuous polymerizers projecting into upper level at Spencer's plant deliver uniform nylon 6.



provides the first zone. It's mounted on a cylindrical column which is equipped with three separate Dowtherm jackets, the three subsequent zones.

▶ **Top to Bottom**—Caprolactam and a solution of catalyst enter the jacketed reactor-head of the polymerizer. After sufficient retention time for completion of the ring-opening reaction, the material flows down to the second reaction zone at the neck of the unit's stem. Separate Dowtherm jacket surrounding this zone delivers heat to drive excess water back into head of polymerizer.

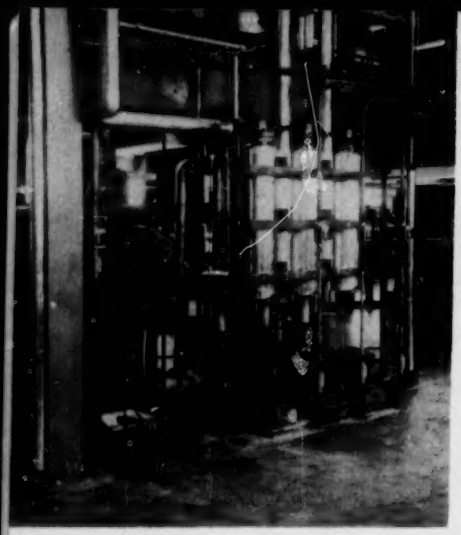
Hydrolysis and polymerization to an optimum point take place in lower two reaction zones, where Dowtherm jackets remove exothermic heat of polymerization. By the time reaction mass leaves polymerizer, it has been in process a number of hours which are determined by the type of polymer being produced.

Temperatures throughout the autoclave generally range between 430 and 560 F.; pressure is roughly 0.5 psig. Complex labyrinthine arrangement of baffles within polymerizer insures uniform distribution of temperature through each reaction zone.

▶ **Molten Feed**—Caprolactam monomer as a 99% molten liquid comes to Henderson in special tank cars from Allied Chemical's Hopewell, Va., plant. Fed into heated, agitated tank, monomer is protected from possible contamination encountered with crushing and melting of former solid feed.

From this point forward, all equipment and lines are:

(*Continued on p. 78*)



DOWTHERM heat exchangers control polymerizer temperatures.

• Steam jacketed or traced to keep caprolactam molten.

• Fabricated of ELC stainless steel to keep iron, for which monomer has despairing affinity, from contaminating caprolactam and final nylon product.

• Blanketed with nitrogen to keep air from interfering with the polymerization reaction.

▶ **On to Polymerizer**—Filtered caprolactam flows into two parallel process lines, identical except for operating conditions. From a calibrated tank, correct volume of monomer flows to another tank and mixes with catalyst solution for 10-15 min.

Supply of mixed monomer and catalyst enters top of 20-ft. high polymerizer from 2,500-lb. feed tank. Flowing down through polymerizer by gravity, reaction mass is metered out of unit by a gear pump feeding spinnerette assembly.

In this unit, polymer passes through screen pack and 0.25-in. holes which form polymer strands. After solidification in water-cooling bath, strands are chopped into pellets and dumped into hoppers for holding until cleared by analytical lab.

▶ **Final Washing**—Nylon 6 polymer contains some unreacted caprolactam and some oligomers (higher ring compounds). There are some uses for polymer containing these materials and Spencer markets a limited amount of it.

But the chief markets for nylon 6 demand material containing only 1-2% of these materials. Therefore, most of Henderson's nylon 6 goes to a leaching operation for removal of caprolactam and oligomers from the polymer.

Leaching is carried out in three 8-hr. cycles using hot demineralized water. Then drained wet pellets are dumped into a glass-lined, jacketed, double-cone, rotating dryer.

Drying proceeds at less than 200 microns Hg abs. with heating medium circulating through jacket. When moisture drops below 0.1%, pellets are cooled by circulating water through jacket.

Discharging from dryer, cooled pellets are screened and packed in 25-lb. hermetically sealed containers.

New Additive Cuts Costs Making Fats, Fatty Acids

An improved process for making fats and fatty acids by low-temperature fractional crystallization promises to reduce investment and operating costs for commercial separation plants.

Key to the new route, reports Girdler Process Equipment Div. of Chemetron Corp., is the use of an additive which controls the type of crystals formed. When feedstock solution (fat or fatty acid in acetone) is cooled, additive causes a slurry to form which is readily filterable.

Too, additive allows rapid or shock chilling in highly efficient Votator heat exchanger and also lowers viscosity of slurries. This permits processing of a slurry with a high solids content, lower ratio of solvent to feed.

Work thus far has been on fats (mostly lard and tallow) and fatty acids (mostly distilled tallow acids, some undistilled tallow acids and a light ends cut from tall oil distillation, which is high in palmitic acid). Plans for future work include cottonseed acids, soybean acids and tall oil fractions.

▶ **One or Two Stages**—Raw materials can be processed according to one-stage or two-stage operation, depending on products and desired purity. Girdler hasn't yet found it necessary to use two-stage fat separation.

In two-stage operation, product is recrystallized and filtered again. This, however, doesn't increase over-all solvent ratio or require additional solvent recovery equipment.

In fatty acid operation, feedstock is mixed with 0.1-0.15% additive, contacted with precooled acetone and quickly chilled to desired filtering temperature. Filter cake is washed with recycle acetone from second-stage wash.

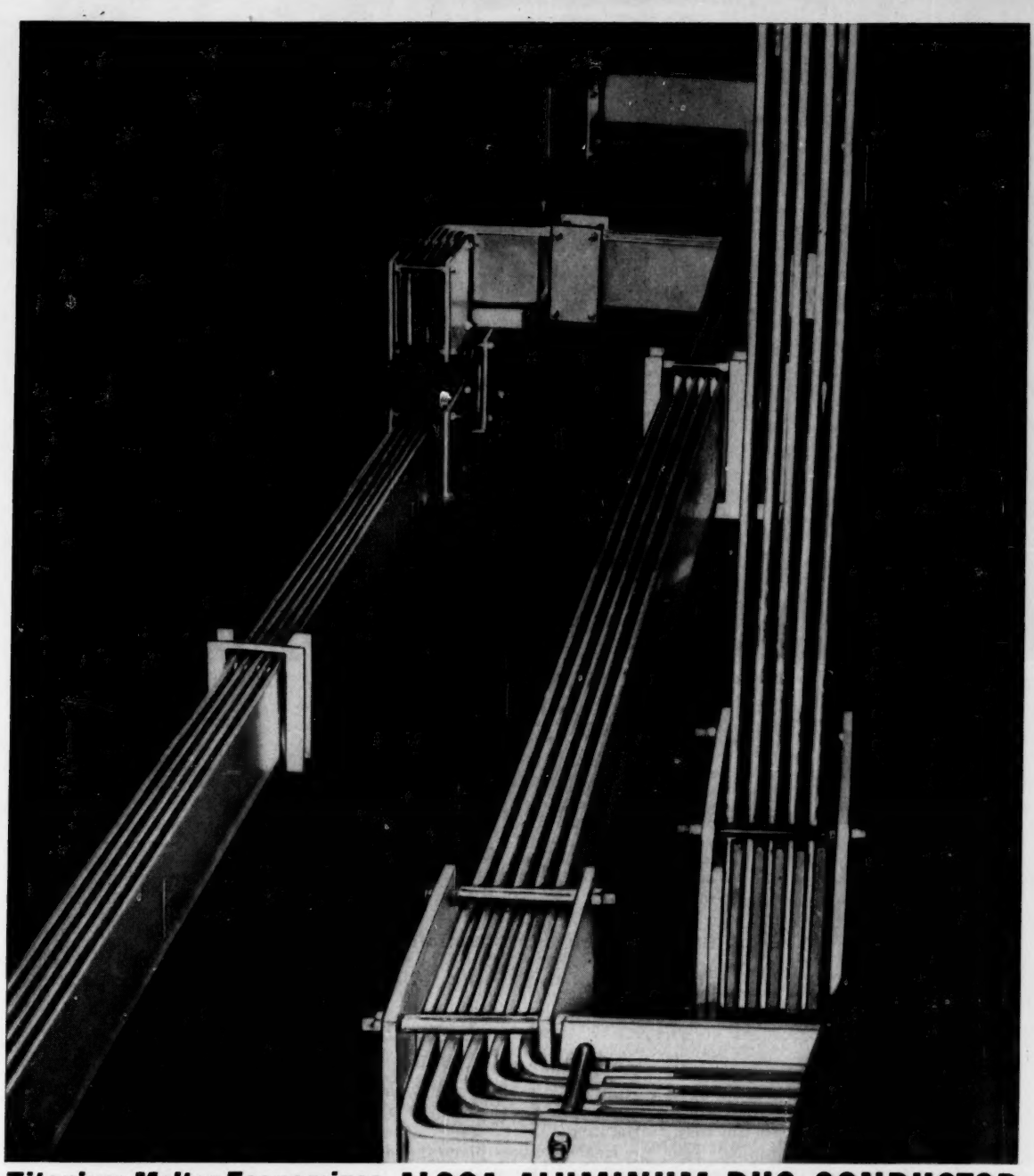
Acetone goes to solvent recovery and filter cake is crystallized, chilled and filtered in a second stage. Fresh acetone is used here for washing. Solvent makeup requirements (for one- or two-stage operation) are about 0.03 gal./100 lb. of feed.

Other processing requirements for a like amount of feedstock at a 2,500-lb./hr. rate: Refrigeration (—10 F., NH_3)—2.7 tons (tallow-acid separation), 1.6 tons (lard destearinization); water at 85 F.—755 gal. (tallow), 450 gal. (lard); electric power—1.5 kwh. (in both cases); 25-psig. steam—about 14 lb.; 125-psig. steam—about 85 lb.

Boron-Paraffin Shields Training Nuclear Reactor

Boron-impregnated paraffin shields Columbia University's new training nuclear reactor. Boron contained in paraffin absorbs neutrons escaping from the reactor. Thus, removable paraffin slabs, weighing but 400 lb., play the role of traditional lead or concrete shielding materials, at a lower cost. And because shielding is relatively light, hand-operated cranes may remove it and thus permit access to the subcritical pile.

Reactor consists of 270, 60-in. long, 4-in.-sq. bars of nuclear-grade graphite, supplied by National Carbon Co. (*Chem. Eng.* Feb. 23, 1959, pp. 114-7). These are notched to permit insertion of 113 aluminum-clad, uranium-oxide fuel elements. A plutonium-beryllium neutron source, inserted in the bottom layer of graphite, supplies neutrons to initiate the fission reaction.



Titanium Melter Economizes With Low-Cost ALCOA ALUMINUM BUS CONDUCTOR

Substantial savings in initial cost accounted for the choice of Alcoa® Aluminum Bus Conductor for Oregon Metallurgical's titanium and refractory metals melting plant. In fact, savings of up to 50 per cent are common when you specify bus conductor of Alcoa Aluminum. With Alcoa Aluminum, you buy equivalent conductivity with only half as many pounds of metal.

Low material cost, low installation and maintenance costs plus easy-to-make connections are strong reasons to use Alcoa Aluminum Bus Conductor. Immediate delivery of rectangular shapes in popular sizes is available from Alcoa or your Alcoa Distributor. For complete information, write for your copy of the *Alcoa Aluminum Bus Conductor Handbook*. Aluminum Company of America, 2120-G Alcoa Building, Pittsburgh 19, Pennsylvania.

Photo above shows Alcoa Aluminum ½" x 9" rectangular bus bar installed at the Oregon Metallurgical Corporation's Albany, Oregon, melting plant.

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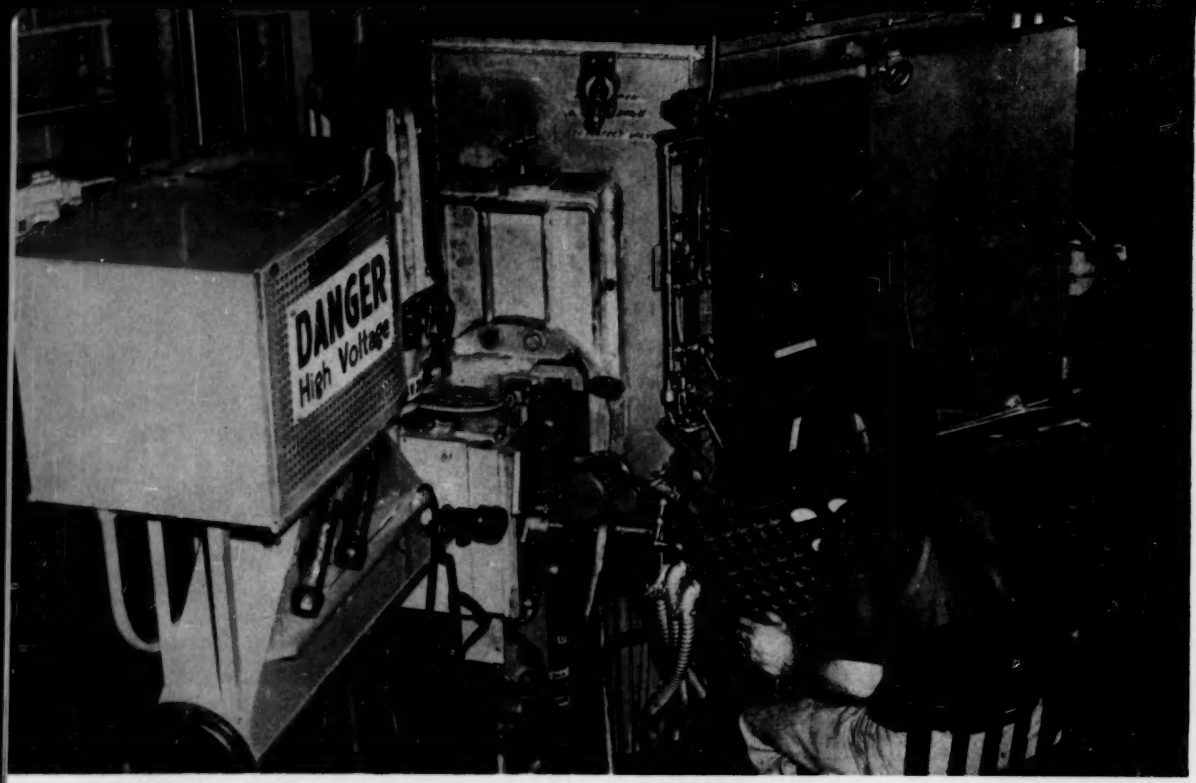

PURER materials for the future are coming from Stauffer-Temescal 225-kw. electron-beam production furnace.

Electron Beams Break Into Production

Scoring an initial breakthrough in production of space-age metals, electron-beam processing rapidly is pushing its advantages into broader areas.

One year ago electron-beam processes were a laboratory curiosity, relegated to the task of refining metal samples. Today electron beam furnaces and welders are production equipment. And a dozen companies are hard at work exploring more commercial possibilities.

Driving force behind these rapid-fire developments is the need for pure materials for "space age" alloys and other special uses.

Electron-beam melting satisfies this need by harnessing the kinetic energy of 10-20-kv. electrons to heat materials without introducing impurities. In most equipment, electrons are boiled from a heated tungsten filament and focused electrostatically on the target.

Heating takes place in a high vacuum (better than 10^{-4} mm. Hg compared with about 10^{-2} mm. Hg for arc melting) so that outgassing takes place to give an ingot low in oxygen, nitrogen and other interstitials. Also, metal impurities more volatile than the feedstock tend to vaporize during melting, giving an added degree of refining.

▶**Big Break**—Turning point in the history of electron-beam processing came earlier this year when Wah Chang Corp., Albany, Ore., purchased a $160,000 furnace from Stauffer-Temescal Co.,* Richmond, Calif. This furnace is now being used to refine columbium, tantalum, zirconium, hafnium, tungsten and molybdenum.

Stauffer-Temescal now is talking about making a 1.5 mw. furnace which would possibly provide an entree to titanium.

Not long after Wah Chang's purchase, NRC Equipment Corp., Newton Highlands, Mass., announced it was offering electron-beam equipment for sale and followed up by selling a $60,000 furnace to Oak Ridge.

Then on March 20, 1959, Al-

*Formerly Temescal Metallurgical Corp. See *J. of Metals*, Feb. 1959, pp. 112-117 for furnace details.

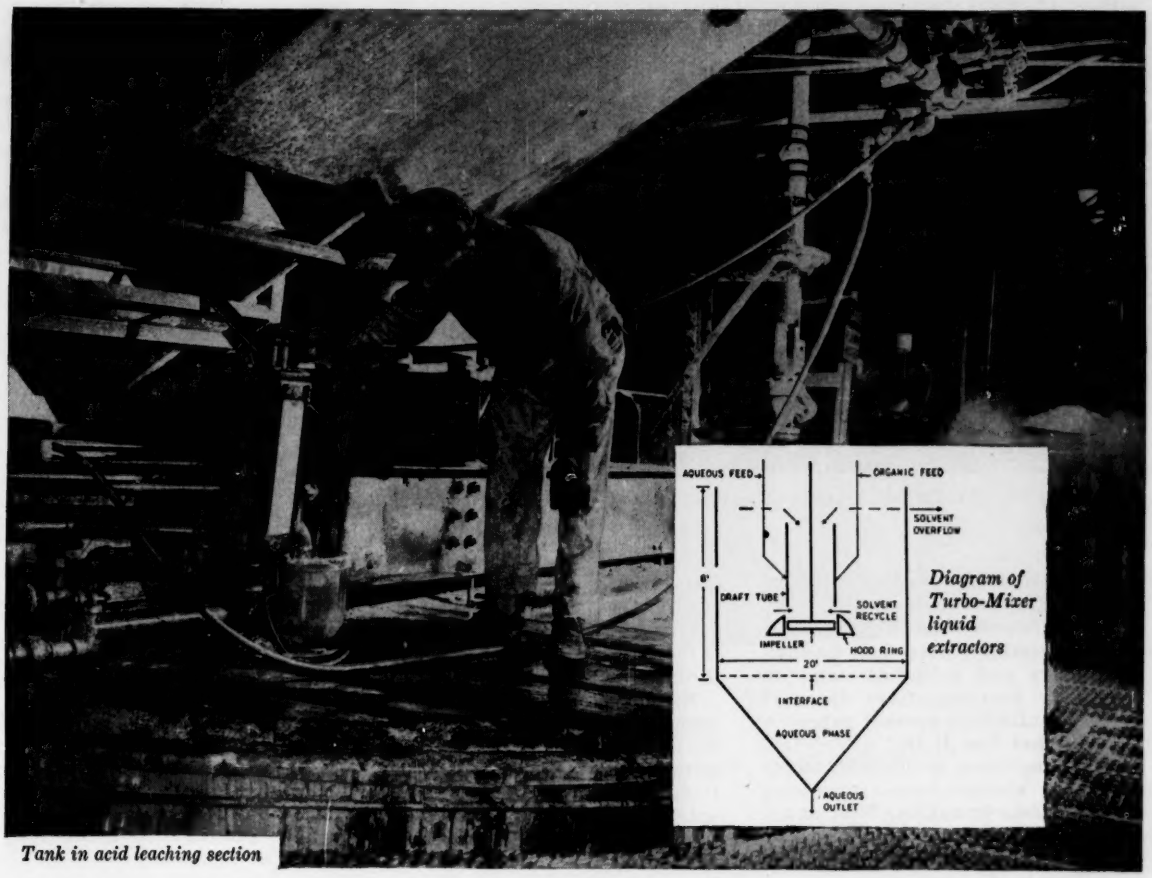

Diagram of Turbo-Mixer liquid extractors

Tank in acid leaching section

VITRO URANIUM HANDLES A WIDE VARIETY OF URANIUM MINERALS WITH TURBO ON THE JOB

When VITRO URANIUM COMPANY of Salt Lake City embarked on a modernization program, they called on GENERAL AMERICAN to assist in the design of the most modern mill possible.

Heart of the plant is the extraction system, and here, GENERAL AMERICAN Turbo-Mixers proved to be key equipment, in both the leaching and liquid extraction sections.

VITRO URANIUM processes a wide variety of uranium minerals which require highly versatile extraction equipment. GENERAL AMERICAN Turbo-Mixers fit this requirement, replacing an outmoded phosphate precipitation operation. Recoveries of uranium fed into the system are "excellent."

As a result of VITRO'S million and a half dollar modernization program, the 660 ton/day mill already has significantly reduced operating costs. Further proof that in processing as in transportation and storage, it pays to plan with GENERAL AMERICAN.

PROGRESS THROUGH BETTER TECHNOLOGY

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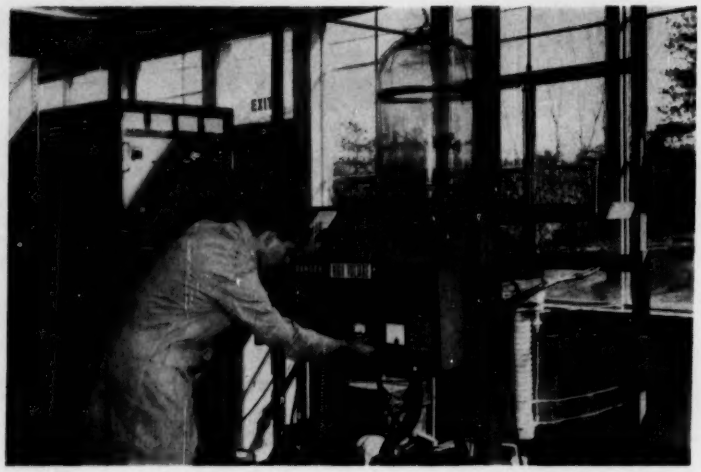


ELECTRON beam welds metals at Nuclear Metals, Concord, Mass.

loyd Research Corp., Watertown, Mass., held a symposium in Boston on electron-beam processing. More than 60 engineers and scientists came to hear representatives from 13 organizations present papers.

▶**What Can It Do?**—Important to engineers is the high purity that electron-beam processing achieves in metals. Most of the columbium now being produced, for example, is melted in electron-beam furnaces.

Starting with a sintered columbium bar, one pass through an electron-beam furnace drops initial carbon (300 ppm.) and nitrogen (500 ppm.) down to less than 30 ppm. Removing these interstitials makes the metal more ductile and malleable and may have a marked improvement on other properties.

Of equal importance electron-beam furnaces can handle any kind of feedstock: powder, sponge, sintered bar or premelted ingot. This permits recycle of scrap (impossible with arc melters) which is a prime necessity with the rarer metals. Too, rate of melting can be readily controlled, tailoring refining to individual ingots.

▶**Proof of the Pudding**—The Stauffer-Temescal furnace can produce 200-lb. ingots of columbium at a 250-lb./hr. rate, taking it out of the "laboratory" class. This is the largest unit on the market.

Wah Chang plans to use its unit in conjunction with, rather than as a replacement for, conventional arc furnaces. Raw metal will be first sintered and semirefined in the vacuum arc furnaces. Then if higher purity is required, sintered stock is run through electron-beam furnace.

Reason for this tandem arrangement is that capacity of the arc melter is higher for initial sintering and is, therefore, more economical. Violent outgassing that may occur on the first run in an electron-beam furnace puts a heavy strain on the vacuum equipment and may interfere with electron beam.

On the other hand, to further refine the metal in arc furnaces would require many passes. Wah Chang feels it has the ideal team in the arc-furnace-electron-beam combination.

▶**What Else Is Happening**—At the Alloyd symposium,[1] many of the latest developments in this field were outlined by the 60 participants.

In Europe, workers use electron-beam furnaces to zone refine metals like molybdenum, nickel and vanadium, and alloys of tantalum and columbium.

In this country, Battelle Memorial Institute reports it is zone refining platinum, ruthenium and palladium for the Office of Naval Research. Most impurities in these metals are reduced below spectrographic limits with electron beams.

Too, Battelle has been zone melting germanium to make large single crystals. And Alloyd reports it is trying a special electron gun for purifying beryllium for the Air Force.

At Massachusetts Institute of Technology, workers have made ceramic-to-molybdenum seals for miniature electronic components using an electron-beam welder.

▶**For Titanium**—Westinghouse says it is investigating electron-beam melting for recovery of scrap titanium and for upgrading off lots.

General Electric has been using electron beams in materials research, has made very ductile tungsten rods by zone refining.

Mallory Sharon has been melting and refining beryllium, boron, titanium carbide and tantalum carbide in its electron-beam furnace.

Bell Laboratories says it has zone-refined silicon-28 for use in masers.

▶**Equipment Available**—High Vacuum Equipment Corp., Hingham, Mass., is marketing an electron-beam welder and says it has achieved good results welding molybdenum to tungsten and beryllium.

Stauffer-Temescal, in addition to its production model furnace, also offers three smaller furnaces and a welding machine.

Air Reduction Co. recently announced that it is marketing a welder that would be custom-built for specific applications.

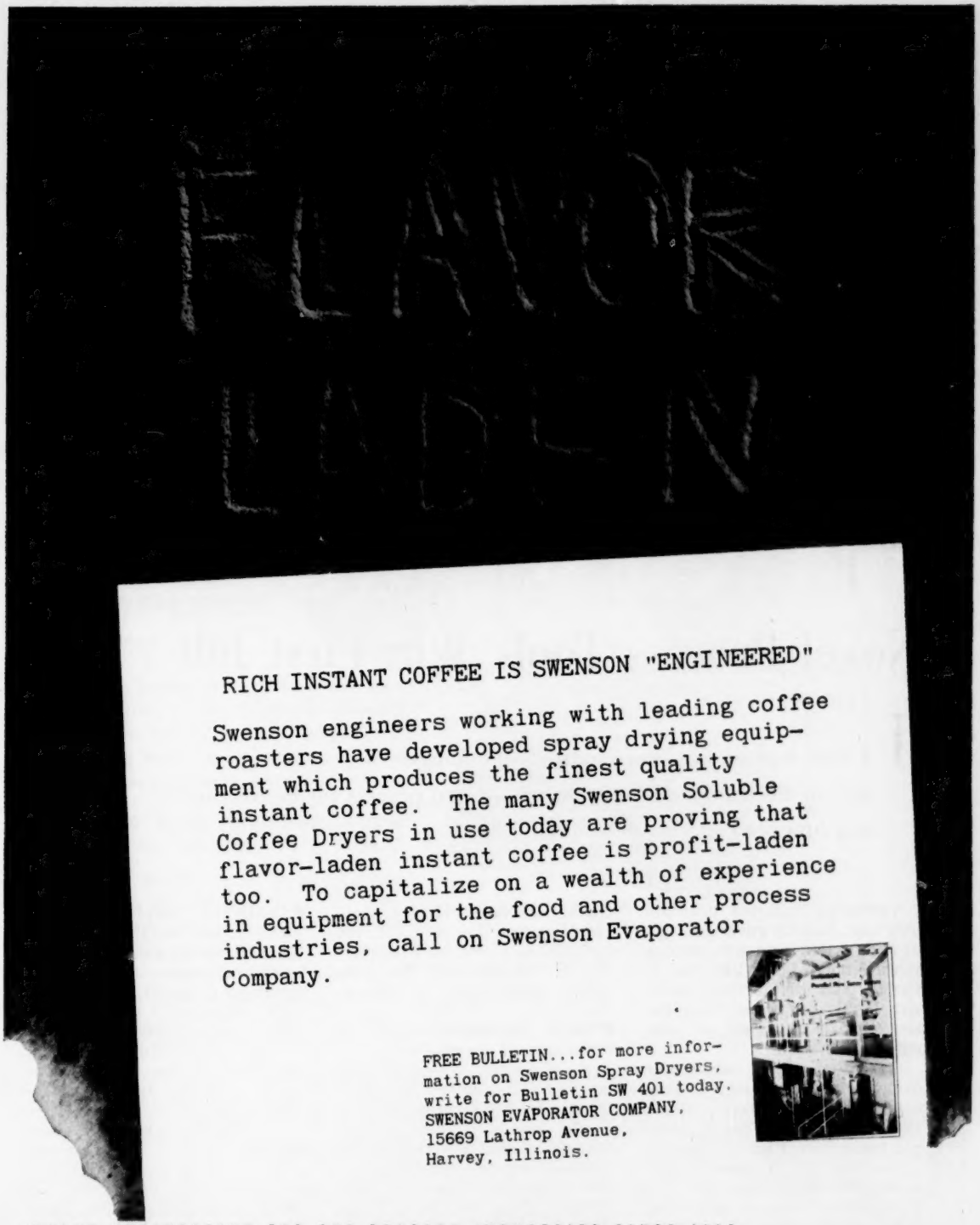
NRC Equipment Corp., as mentioned before, also markets a furnace and a welder.

Alloyd Corp., sponsor of the symposium, announces that it has under construction a flexible electron-beam facility that will drip-melt, weld and zone-refine, all in a single unit. This facility will be used primarily for laboratory investigations.

▶**Some Dissenting Voices**—Amid the heady enthusiasm being aroused by this new tool, notes of caution are sounded by two companies in the metals field.

Du Pont and Union Carbide Metals, both columbium producers, say that they like the results achieved with electron-beam melting. But both say they have developed cheaper ways for obtaining the same results—without revealing how they do it.

[1] Transcript of the symposium proceedings may be obtained by writing to Alloyd Research Corp., 202 Arsenal St., Watertown 72, Mass.



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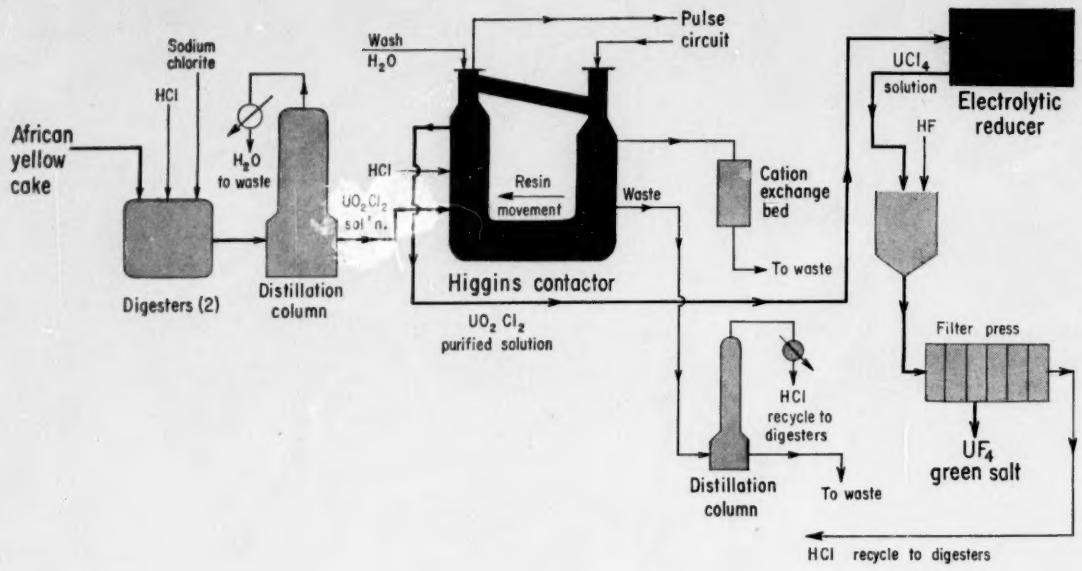

Novel Process Tools Win First Job

A new type of semicontinuous ion exchanger and an electrodialyzer team up to shorten process for converting uranium ore concentrates to metal.

Venturing into the uranium business, Japan's government is proving out a new wet process route from U_3O_8 to UF_4 that is shorter and simpler than present U. S. processes, requires less capital investment per unit output.

Operating on a semiworks scale since early spring at government owned Atomic Fuels Corp., Tokai-Mura, Japan, process has attained initial success. According to U. S. process engineer William Nixon, just returned from startup activities, high purity slugs of uranium metal were produced from process's green salt (UF_4).

Credit for this achievement is shared by Atomic Fuels with Nixon's firm of Weinrich & Assoc., Washington, D. C., which was responsible for design based on Oak Ridge National Laboratory Excer process. Construction was handled by Chiyoda Chemical Engineering & Construction Co., Ltd., under subcontract to Assano Bussan Co. of Toyko.

▶**Novel Equipment**—Keys to simplicity of process are novel units of process equipment used commercially for the first time. To purify the uranium, Atomic Fuels uses a Higgins contactor. Developed by ORNL, this semicontinuous ion-exchanger was supplied by Chemical Separations Corp. of Oak Ridge, Tenn., and Illinois Water Treatment Co. of Rockford, Ill. (*Chem. Eng.*, July 1957, pp. 184-188).

Reduction of uranium to tetravalent salt prior to precipitation is carried out in electrolytic reducer developed by joint efforts of ORNL and Ionics, Inc., Cambridge, Mass.

▶**Contactor Simplifies** — Higgins ion-exchange contactor plays the same purification role as the multistage solvent extraction used to purify U_3O_8 (yellow cake) concentrate in U. S. processes now operating.

Pure uranyl chloride solution, produced by the Higgins contactor, requires little more in-process purification; impurity content falls in the parts-per-million range. Thus, Atomic Fuels may skip crystallization and calcination steps and feed uranyl chloride solution direct to its electrolytic reducer, without pretreatment.

The Higgins contactor's single ion-exchange assembly takes up only 15 sq. ft. of floor space, much less than needed for bulky solvent extraction and stripping vessels. And automatic operation of valves facilitates contin-

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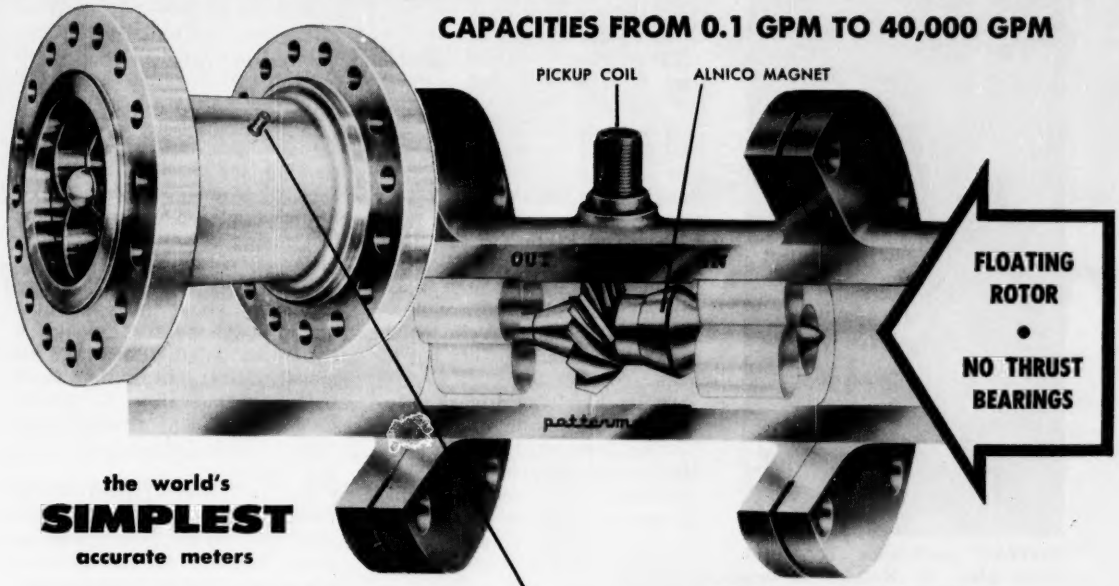

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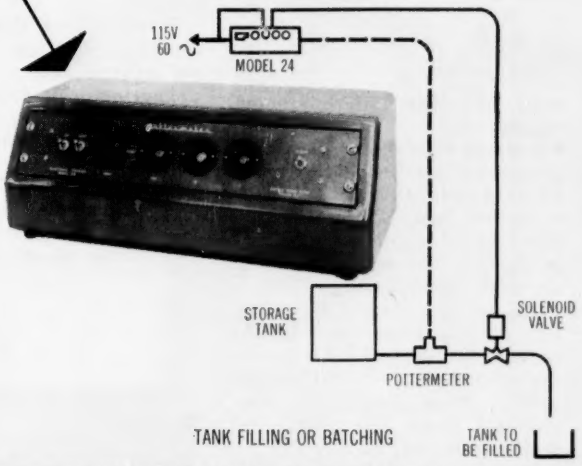

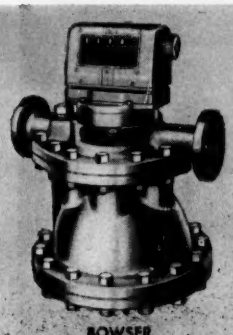

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BOWSER XACTO METERS AND PROPORTIONERS

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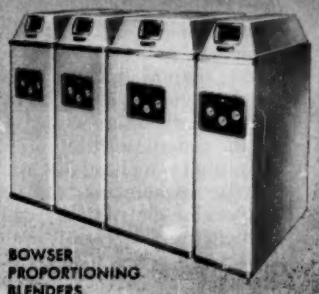

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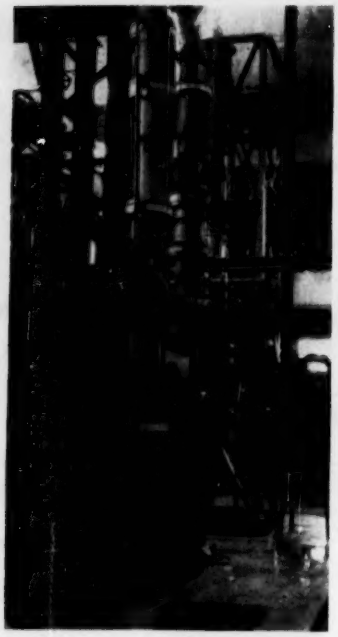


INITIAL purification of UO_2Cl_2 takes place in Higgins column.

uous operation with minimum manpower.

▶ **Reducer Cuts Steps**—With its new electrolytic reducer, Atomic Fuels avoids difficult fluid-bed reduction and HF-gas hydrofluorination steps that are used in the U. S. (*Chem. Eng.*, March 23, 1959, pp. 147-150).

Taking uranyl chloride (UO_2Cl_2) directly from the Higgins column, the electrolytic cell produces uranium tetrachloride (UCl_4). Then aqueous HF precipitates green salt (UF_4) directly from cell liquor.

▶ **Start on Yellow**—Atomic Fuels' process starts by digesting African yellow cake with dilute HCl (5%) to form uranyl chloride solution. Oxidizing agent, sodium chlorite, added to the two rubber-lined, agitated, 200-gal. digester vessels, assures complete dissolution of uranium in the hexavalent state.

After dissolution, continuous evaporator-distillation column concentrates digestion liquor to 250 g./l. uranium content, discharging HCl-free water vapor overhead. Concentrated liquor feeds directly to the Higgins ion-exchange contactor.

▶ **Load Resin**—Contactor consists of a 25-ft. high loop of 7.5-in. rubber-lined iron pipe equipped with fittings to facilitate resin-bed pulsing and ion exchange in a two-phase cycle.

Feed liquor flows into the bottom of the left leg during the 2-3-min. solution-pumping phase. Flowing counterclockwise around the bottom of the loop, liquor gives up uranyl chloride to the ion exchange resin.

▶ **Wash and Elute**—At the same time that feed is flowing through bottom of loop, wash and eluting solutions are flowing through loaded resin which has been pulsed up left leg of loop.

Hydrochloric acid wash solution enters middle of left leg flowing downward to join feed. Mixture of impurity-laden acid and barren acid feed liquor discharges out bottom of right leg to a distillation column which purifies acid for recycle to digesters.

Water eluent flows into the top of the left leg. Raising the pH of the resin, it picks up uranyl chloride from the resin and carries it out the product outlet in the middle of the left leg.

▶ **Pulse Resin**—At the end of the solution-pumping phase, valves automatically cut off flow of feed, wash, eluent, product and waste streams. Then, pulse pump on right leg of loop shifts the resin bed 3-4 in. clockwise, or up the left leg.

This takes only 5-10 sec., or 2.6-5.2% of the total cycle time. Valves, then opened, again permit streams to flow to and from loop.

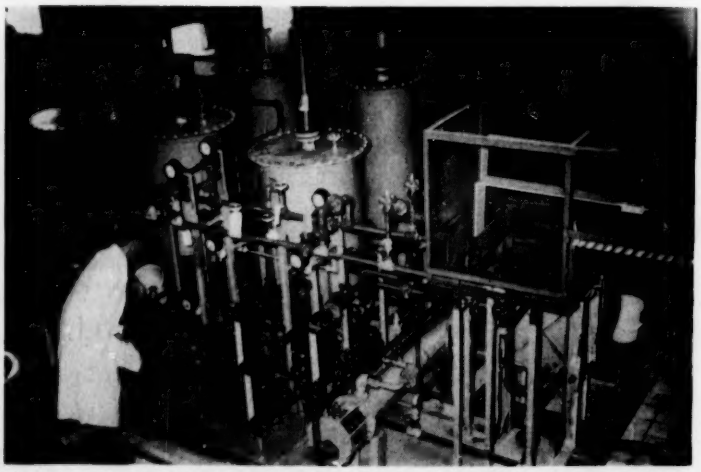
Slippage outlet in the right leg prevents loss of uranium-bearing liquor out the waste outlet. Slippage consists of liquor displaced with the resin bed during pulse or transitional phase of cycle.

Monitored by conductivity probe just above the waste outlet, slippage passes through a cation-exchange column for removal of trace uranium values before discharging to waste. Cation bed eluent returns uranium values to feed stream entering contactor.

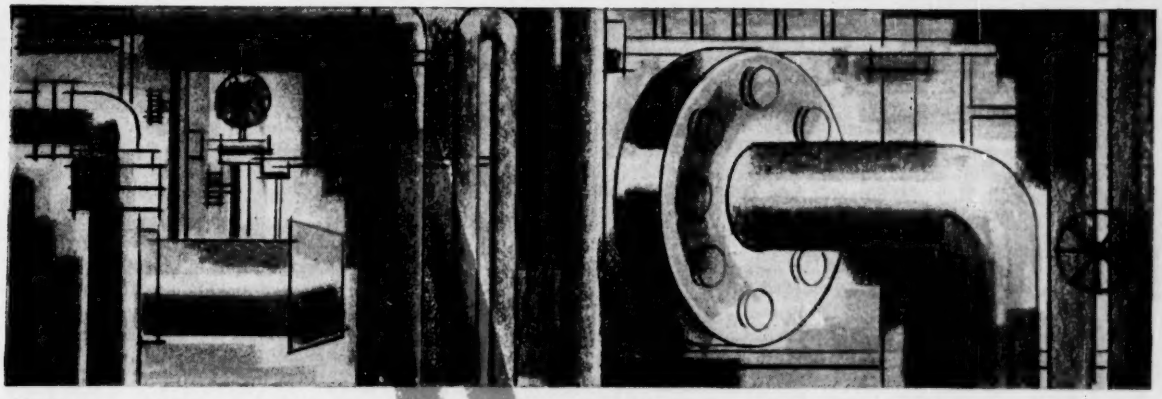
▶ **Reduce Electrolytically**—Purified uranyl chloride solution (50-100 g./1. U) from contactor flows directly to the cathode chamber of electrolytic reducer, a filter-press type bank of 12 diaphragm cells.

In anode chamber of each cell, sulfuric acid electrolyzes releasing hydrogen ion and free oxygen. Hydrogen ion migrates through the cell's dialysis membrane to the cathode chamber.

At the cathode, uranyl ion decomposes to form reduced uranic ion (U^{+4}) and oxygen ion



FINAL purification by electrolysis cell (right) converts UO_2Cl_2 to UCl_4.



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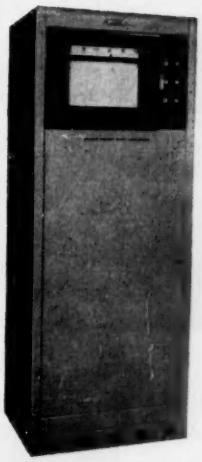


which reacts with migrant hydrogen ion to form water. Uranic ion joins with freed chloride ion to form uranium tetrachloride. Membrane prevents flow of corrosive chloride to anode chamber.

▶ **Final Steps**—Uranium tetrachloride solution from electrolytic cells is treated with aqueous HF to precipitate green salt. After filtration and drying, green salt is dehydrated at 830 F. in nickel-lined electric furnace.

Reduction of green salt with magnesium in bomb produces uranium metal which receives final purification by vacuum remelting.

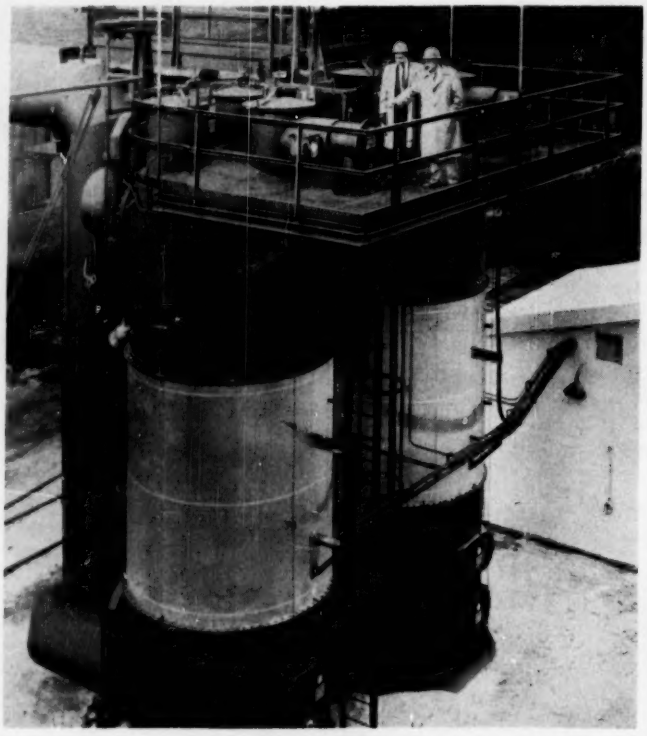
Polycarbonates Moving Into Commercial Plants

Next month General Electric is scheduled to break ground for a multimillion dollar polycarbonate plant near Mount Vernon, Ind., on the Ohio River. Though not to be pinned down on capacity figures, GE hints at production of at least 5 million lb./yr. New unit is designed for rapid expansion, with a possible output of 25 million lb./yr. as markets develop.

This development follows not too many weeks after an announcement by Germany's Farbenfabriken Bayer that it had started production of a polycarbonate tradenamed Makrolon (including a film, Makrofol). Monomeric unit of Makrolon, Bayer reveals, is the carbonate of bis-phenol A (for structural formula of this unit, see *Chem. Eng.*, May 1957, p. 144).

GE plans to have its plant in large-scale production by the third quarter of 1960, and, like Bayer, will use bis-phenol A and phosgene as chief raw materials. When the plant is in full operation, GE hopes to lower the price of its resin (tradenamed Lexan) from $2.50/lb. to $1.25/lb. First Lexan market will be molding compounds, but already in development stages are polycarbonate elastomers, films and fibers.

Bayer's Makrolon now comes in two forms, one for injection molding and the other for extrusion processing. And Bayer is now marketing its Makrofol film (20-200 microns thick) made from Makrolon by slot extrusion or casting from solution.



Electrostatic Precipitators Detar Coke-Oven Gas

Twin electrostatic precipitators recently installed at the Cleveland plant of U. S. Steel's American Steel & Wire Div. have boosted product quality of naphthalene produced there. Units remove 96% or more of particulate matter from a total of 29,900 cfm. of coke-oven gas. Designed and built by Metal Products Div. of Koppers Co., precipitators are equipped controlled-corona discharge electrodes.

NEWS BRIEFS

Rocket engine: Aerojet-General Corp. recently announced plans for a solid-fuel rocket engine capable of generating 1 million lb. of thrust for satellites and space exploration projects. Aerojet will spend $250,000 on a feasibility study at its Sacramento, Calif., solid propellant plant.

High-temperature plastics: Soviet "Institute for Plastic Masses" has developed furfural-based resins which stand up well under temperatures of −60 to 360 C., according to a Rumanian technical magazine. These resins have withstood temperatures of 2,000 C. for a short time, the magazine adds.

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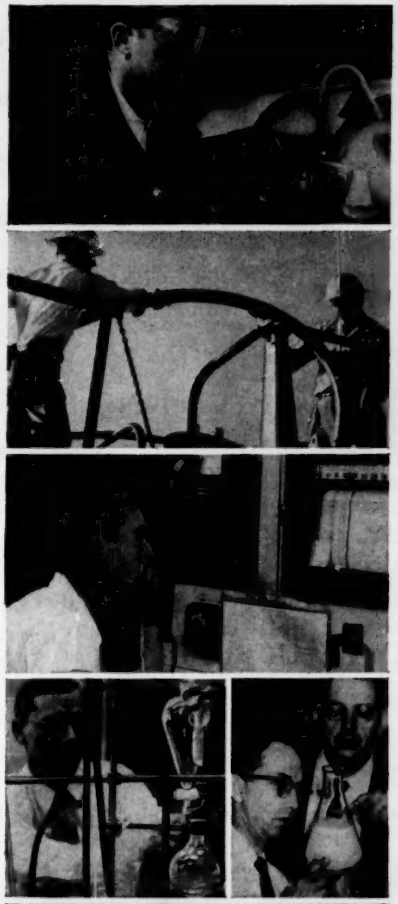
For specifications and local offices, see our insert in Chemical Materials Catalog, pages 435-442 and in Chemical Week Buyers Guide, pages 35-42.



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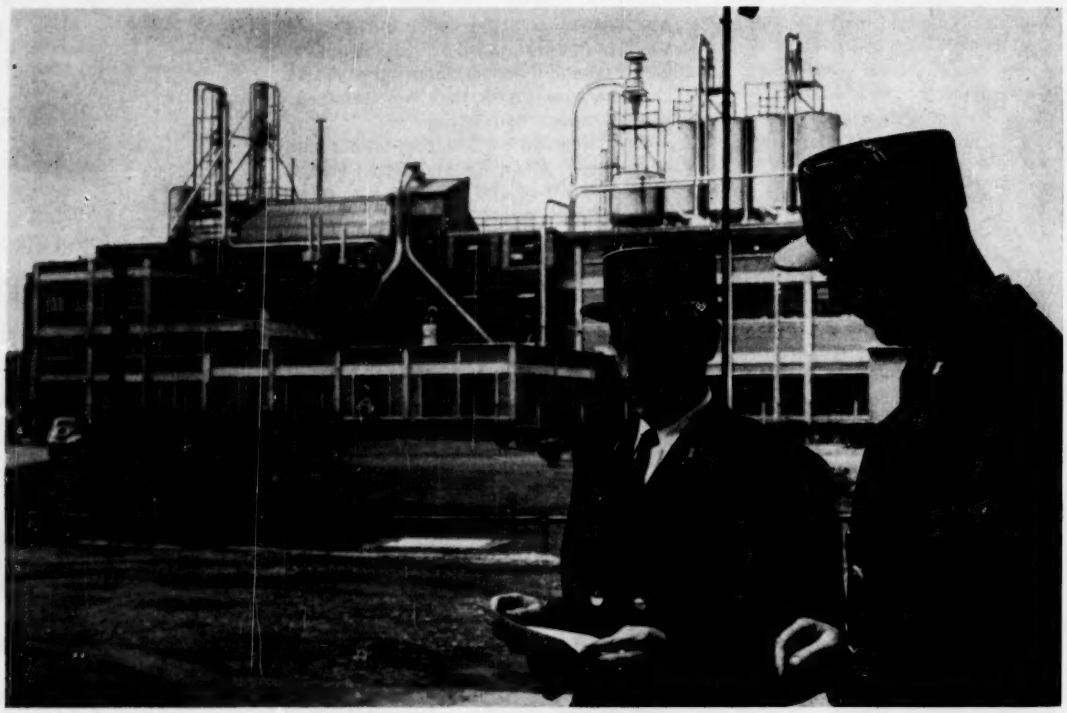


POLYSTYRENE plant of Monsanto-Boussois at Wingles, France, is going through another round of expansion.

Make Chemicals Abroad? Watch Your Step

There's profit overseas for the taking. But chemical processors had better steer clear of booby traps all along the way.

E. B. Seaton, Director of Overseas Development, Monsanto Chemical Co., St. Louis, Mo.

Why does anyone contemplate overseas chemical manufacture? To make money, obviously. For there can be profit in moving abroad, through licensing know-how (technical, commercial, financial, management), establishing foreign plants, creating outlets for raw materials and securing raw materials for use.

But all is not clear sailing in overseas licensing and manufacture, despite all the general conversation about opportunities. Too often the pitfalls are not mentioned, or are simply glossed over. Pitfalls may in many ways outweigh potentials.

▶ **First Principles**—So in trying to make money overseas, let's keep some principles in mind:

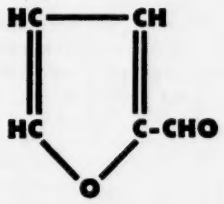
Overseas chemical manufacture must compete for capital with domestic demands. It must earn at least equivalent returns —and generally more.

Overseas manufacture should

A TECHNICAL MEMO FROM THE QUAKER OATS COMPANY ON

QO® FURFURAL FOR NEW PRODUCT OR NEW PROCESS DEVELOPMENT

If you are interested in product development or process improvement, take a look at QO furfural.



GENERAL PHYSICAL PROPERTIES

Boiling point (at 760 mm), °C.	161.7
Freezing point, °C.	−36.5
Refractive index (n 20/D)	1.524-7
Specific gravity, 20/20	1.161-3
Solubility in	
water (wt. % at 20°C.)	8.3
alcohol; ether	∞

FLUID PROPERTIES

Viscosity, cps. at 25°C.	1.49
at 38°C.	1.35
Surface tension, dynes/cm. at 30.0°C.	41.1
Vapor diffusion coefficient, cm^2/sec.	
at 25°C.	0.087

THERMODYNAMIC PROPERTIES

Heat of vaporization, $\Delta H_{433.8}$ kcal./mole	10.22
Thermal conductivity, B.T.U./(hr.)	
(sq. ft.) (°F./ft.) at 100°F.	0.1525

IDEAS TO INVESTIGATE

Want to start something new? Less than a "bit" will buy you a pound of this chemical in tank car lots and offer a mighty convenient starting point for synthesis of many intermediates. Reaction environments determine the nature of the end products—either ring types or open chain compounds are yours.

In an entirely different vein—furfural is a really useful tool for separating mixtures. Solvent separation of metal derivatives is rather readily achieved with this organic. Preliminary studies made on zinc salts and on rare-earths metals, invite a broader look into other metal recovery problems, generally.

MORE IDEAS

Solvent action on phenolic resin and surface wetting effects on minerals have led directly to use of furfural in abrasive wheels, discs and papers, also brake linings and other resin bonded articles.

And if you are interested in a recoverable solvent for reuse, furfural's stability will serve you, as it does others, even at temperatures as high as 450°F.

THE BIG IDEA

You can't do everything with furfural—it won't replace the coffee break—but you can use it a lot of ways. Take 10 minutes and exchange ideas about it with your colleagues. You'll find your exchange has proved profitable. We'll help matters along by sending our Bulletin on Physical Data on Furfural, if you'll ask for it.

For your copy of Bulletin 203-A, write to any one of the offices listed below.

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be evaluated not only in terms of profitability but in terms of basic political, social and economic factors in the foreign country.

Overseas chemical manufacture must be completely accepted in the local economy, particularly in the light of government and public relations. You must have social responsibility in the country and proper personnel relations. Overseas manufacture must, if at all possible, contribute more to the over-all economy than is contributed by the established local industry.

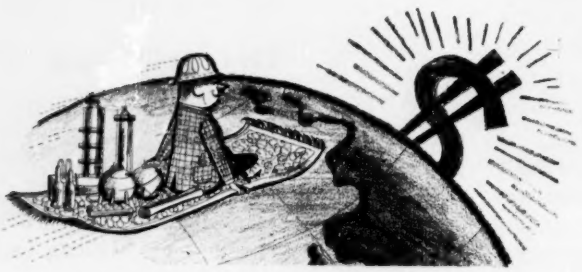
Overseas manufacture should supply a product for which there is a basic need, one that will benefit the whole economy. And it should employ a process suitable to that economy.

▶ **License or Build?**—With these conditions in mind, how do we get into overseas operations? You can license your know-how or build a plant to use it.

A licensing agreement can be a straightforward arrangement to make know-how available for cash and/or royalties. Although generally made company to company, these arrangements usually require foreign government approval—which may not always be automatic.

You can set up production facilities abroad—in which you have full or partial equity—with cash, loans in local currency, raw materials in exchange for local currency, or with know-how and patents in trade for the equity. (Monsanto has exchanged know-how for as much as 50% equity and as little as 2% equity.)

▶ **Where's the Payoff?**—Now we've observed the precautions and taken the necessary steps. How does overseas activity pay off?



Pros and Cons of Overseas Participation

How You Can **Win**	How You Can **Lose**
Make a profit.	Your investment may be expropriated. Treaties may hamper crediting of taxes paid overseas. Currency shortages may tie up dividends.
Break into markets closed to your products—by making the products in the market.	Customers may discriminate against your product because it's produced in a foreign-owned plant.
Force outlets for raw materials from home company by setting up a "captive market."	Import controls, short foreign exchange may block sale of exports from home company.
Pick up raw materials needed at home.	Home-government quotas may restrict imports.
Collect royalties and/or cash for know-how.	Your know-how may be used to make and export products which compete with you for home markets. Inflation may dissipate your rewards. Unless you provide continuous know-how, your licensee may be unable to return a profit.

You can participate in markets not otherwise available because of import and currency restrictions, or tariff barriers. Local manufacturing usually provides a larger market than could be obtained by export alone. Convenience of buying locally, in local currency, without red tape and need for currency deposits, stimulates local demand for your product.

You can tap additional markets by exporting from your overseas plant. A product made in country A, having special trade relations with country or area B, can often be exported preferentially to country B.

You can provide an outlet for raw materials of the parent company. Until overseas manufacturing volume is sufficient to justify local manufacture of necessary raw materials, they may have to be imported. You are a logical supplier. Overseas manufacture furnishes a captive market.

You can secure raw materials needed by the parent company. Although more typical of extractive industries, this situation can be important in chemicals, too.

You can get payment for services rendered—a "skill" fee. This "skill" can include production methods, management techniques, sales organization, distribution methods, etc.

▶ **Licensing Pitfalls**—Now some precautions to keep you from getting burned in a licensing agreement:

Make sure you and your partner or partners have a common meeting of minds on exactly what is intended. There can be a language barrier—absolute fluency in a foreign language is not easy to find. Sometimes differences can come up five years or more later on what the basic interpretation of the field of agreement should be.

Consider inflation when establishing royalty rates. Sometimes it's better to tie royalty rate to selling price, sometimes to output. Take into account the alternatives: cash payment or running royalty. Keep in mind the effect of discounted cash flow in establishing the total return expected for your know-how.

Think seriously about providing continuous know-how. With-

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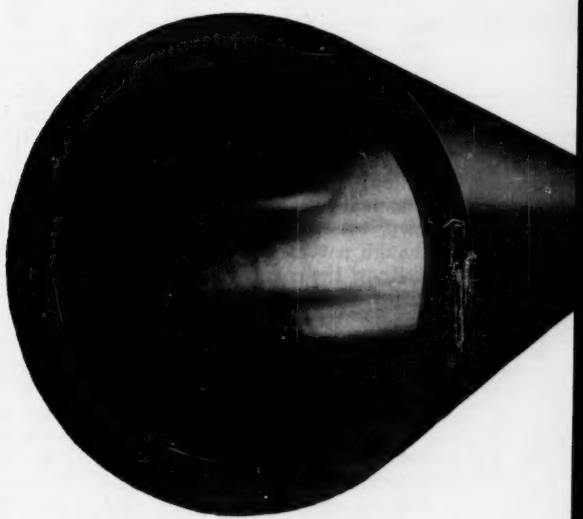
FACT:

In sulfuric acid Byers PVC Pipe can out-perform stainless at 1/5 the cost



Stainless steel pipe often *fails* where Byers PVC Pipe *doesn't.*

Typical are sulfuric acid applications. Here, Byers PVC Pipe will not only out-perform stainless in terms of corrosion resistance — it also *costs less.* Only 1/5 the cost of stainless. That's why specification of Byers PVC Pipe makes such solid sense in this service.

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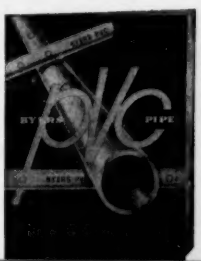


out a flow of knowledge the licensee's operations may bog down and produce no royalties.

Check local tax regulations on royalties.

Remember that once you license your know-how to a foreign company, the product may be exported to your own country to compete against you.

▶**Manufacturing Pitfalls** — What you should look out for in setting up an overseas plant:

There may be local discrimination against your products because they are turned out by a foreign-owned concern. Thus 100% equity in an overseas operation—while it provides complete freedom to management—can be a special disadvantage. You can get around this somewhat by setting up something less than 100% equity ownership (you may have to).

But having a partner is like getting married—you must be prepared to share, and recognize the honeymoon may not last forever. Sometimes one partner may wish to expand while the other is opposed to this. Or there may be different objectives in setting prices; in certain regions it's a general practice to keep prices high and production down—even though lower charges might expand the market.

You should agree on dividend policy; in some countries it's customary to borrow, if necessary, to pay dividends even though not earned.

Know the commercial codes in a foreign country in order to understand, for example, the rights of a minority interest. Sometimes a 25-30% ownership has equal vote with the majority shareowner.

Review tax treaties existing between the U. S. and a foreign country. Study regulations concerning crediting of taxes paid overseas, or exchange of know-how for equity.

▶**Can You Collect Profits?**—Know the local government's regulations on repartition of dividends and equity. It may be impossible to transmit your dividends from a foreign company which earned a good profit.

One company was unable to recoup substantial dividends because it could not convert the foreign currency into dollars. So it used its foreign cash to produce a movie locally, which it sent to the U. S. for showing. Profits from the movie (in dollars, of course) were, in effect, profit from overseas operation.

Figure the odds of having your overseas investment expropriated. In some foreign countries the risk is large.

Try to hedge, if you can, against effects of inflation—but don't outfox yourself. In Argentina, raw materials were imported two years ago at an exchange rate of 7.5 pesos to the dollar; equipment was brought in at 14 pesos to the dollar. Now the free exchange rate for most imports is over 70 pesos.

Unfortunately, products made from imported raw materials haven't kept pace with the peso's decline in Argentina.

A North American company, on the other hand, made a major investment in Brazil, basing its capital appropriation on the expectation that the cruzeiro would devalue from 70 to 120-130 to the dollar. But the cruzeiro held steady during construction and an additional $1.5 million had to be shelled out to see the building through.

Interest rates, incidentally, are high in many foreign countries—14% is often a standard rate and 36% is not unknown—a sign of inflation as well as tight money. Look on at least a portion of the high interest rate as "insurance" against inflation.

▶**Imports Cutoff** — Another overseas pitfall: import controls—they may cut off your raw material supplies. If the raw material available locally is not exactly suited to your needs, you may find yourself in a real bind.

Import controls—and shortage of foreign exchange—may also seal off the "captive market" for your U. S.-produced raw materials.

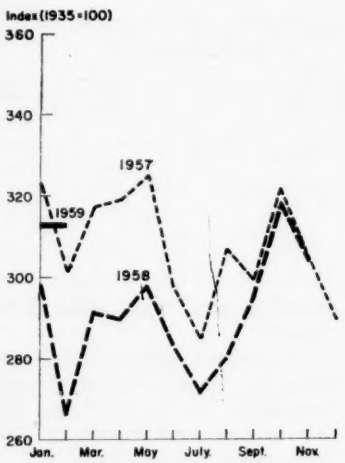
And sooner or later, import controls or no import controls, manufacture of the raw material will be carried out—if you don't do it some one else will—in the foreign country, cutting off the market to export.

Now suppose you wish to import some of the materials you're producing overseas; they may be good raw materials for domestic operations. U. S. government regulations—like the mandatory petroleum quotas presently in effect—may restrict the import of these advantageous materials.

Can these pitfalls be avoided? They are being avoided. But only through recognition that overseas chemical business is a complex operation, that only strong organization can meet the challenge. Halfway measures are not enough in today's world.

E. B. SEATON, a chemical engineer, has a busy time tending to Monsanto's interests in 14 companies in 12 foreign countries. This article evolved from a talk he gave last year at a Montreal meeting of the Chemical Institute of Canada.

Chemical Consumption



Consumption by Industries

	Jan. (Rev.)	Feb. (Rev.)
Coal products	9.5	9.5
Explosives	8.8	9.6
Fertilizer	73.4	78.9
Glass	25.6	25.4
Iron & steel	17.1	17.6
Leather	4.3	4.3
Paint & varnish	29.4	28.8
Petroleum refining	32.0	29.4
Plastics	32.0	30.7
Pulp & paper	39.3	37.1
Rayon	26.4	25.3
Rubber	7.7	7.5
Textiles	10.3	9.7
Total	**316**	**314**

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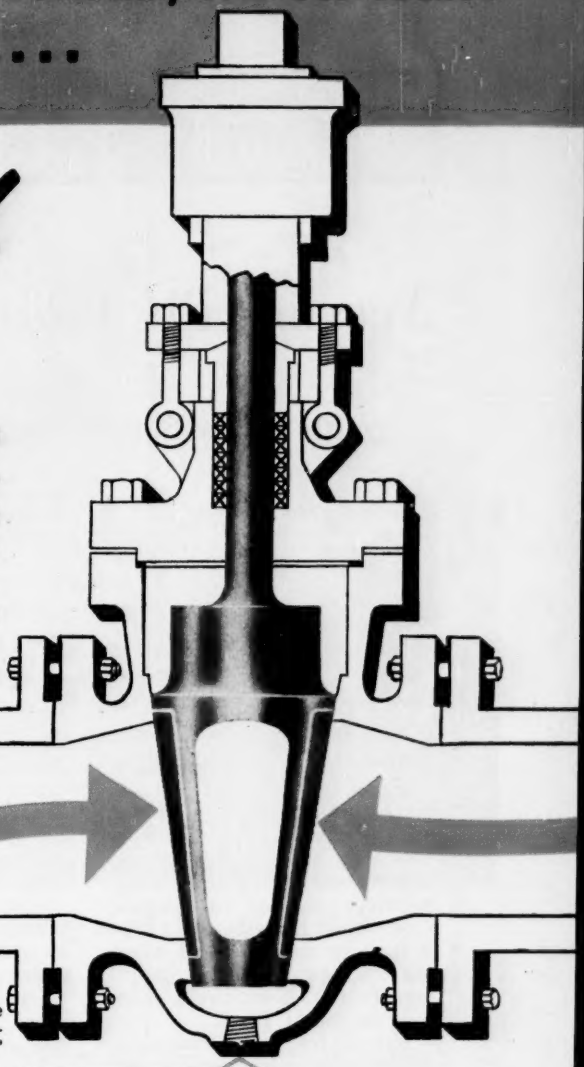
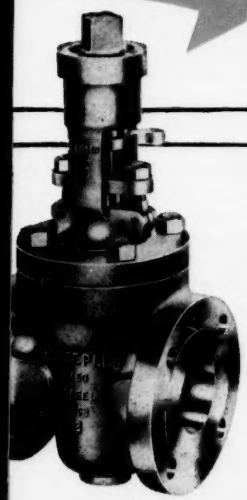
's the valve you've been waiting for—Stockham's new Wedgeplug* Seal." It not only solves all your leakage problems for good **without ication**—but also does the work of 2 valves or a line blind. That's economy!

The two Teflon* "O" rings in the plug do the trick—give constant r-tight shut-off on both the upstream and downstream seats. And O-Seal" is **non-lubricated**—cuts maintenance costs **from now on!**





Because of the double pressure-sealing effect of the "O" rings, the upstream seats as well as the downstream seats of this new valve hold "bubble-tight" against line pressure.

The plug in the bottom boss can be pulled to provide the **tell-tale bleed.** In extensive field and laboratory tests, this valve held bottle-tight on the upstream as well as the downstream seats when the bottom plug was removed. There is absolutely no mixing of products in manifolds.

Thus the "O-Seal" can do the job of two ordinary valves or a line blind in most services.

Your Stockham representative will advise you about the recommended services for the "O-Seal's" double-block and bleed feature.

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Stockham's new "O-Seal" is recommended for all general services—air, gas, water, steam, propane, hydrocarbons, etc., as well as for hard-to-hold services. Recommended for temperatures from minus 300° F to plus 400° F and not exceeding 720 psi.

Available in carbon and alloy steels, 2"- 12" sizes, 150 and 300 lb. pressures. Three port openings—40%, 70%, full round-wrench, handwheel, gear, and motor operated.

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Acrylics Ply Industrial Paint Market:

. . . With Water-Based Enamel

Baked Film Properties	New Water-Based Acrylic	Conventional Alkyd-Melamine
Pigment/binder	60/100	50/50
% Solids	53	55
Tukon hardness	18	14
Gloss (60°)	80	80
Knife adhesion	Excellent	Fair-good
Impact	OK 30-in. lb.	Fails 20-in. lb.
Flexibility	OK	Very fine cracks

Acrylics are now making a bid for the industrial coatings market. About the only one of the paint industry's major markets they haven't already tapped, it requires glossy, hard-wearing coatings for metals. Currently representing $600 million or so in annual sales, the market has gone pretty largely to solvent-based coatings in recent years.

But a few paint manufacturers have started to come out with solvent-based acrylic formulations said to bake dry to films superior in gloss and chemical resistance to the best of their alkyd competitors. The new formulations are equipped with cross-linking agents which help to endow the thermoplastic acrylic polymer with thermosetting characteristics (*Chem. Eng.*, May 19, 1958, p. 62). Now Rohm & Haas has introduced a thermosetting acrylic binder called Acryloid AT-50 to permit still greater improvement.

More unusual, the company is introducing an aqueous emulsion of an acrylic polymer, Rhoplex AC-200, for use in top coats and primers for appliances, autos, other applications for which baking finishes are utilized.

Water-based coatings are a rarity in the industrial field, particularly as top coats. Exceptions: There has been some use of water-based latices as primers; Reichhold and American Cyanamid sell water-thinnable alkyd bases.

The new R & H product converts on baking to hard, glossy films possessing exceptional water, chemical, and humidity resistance, adhesion and impact resistance. In addition, it has the properties characteristic of the acrylic polymers, particularly excellent color and color retention, stability and durability.

The table above favorably compares a white enamel formulation made with Rhoplex AC-200 with conventional white alkyd enamel after a 30-min., 300 F. bake on unprimed cold roll steel.

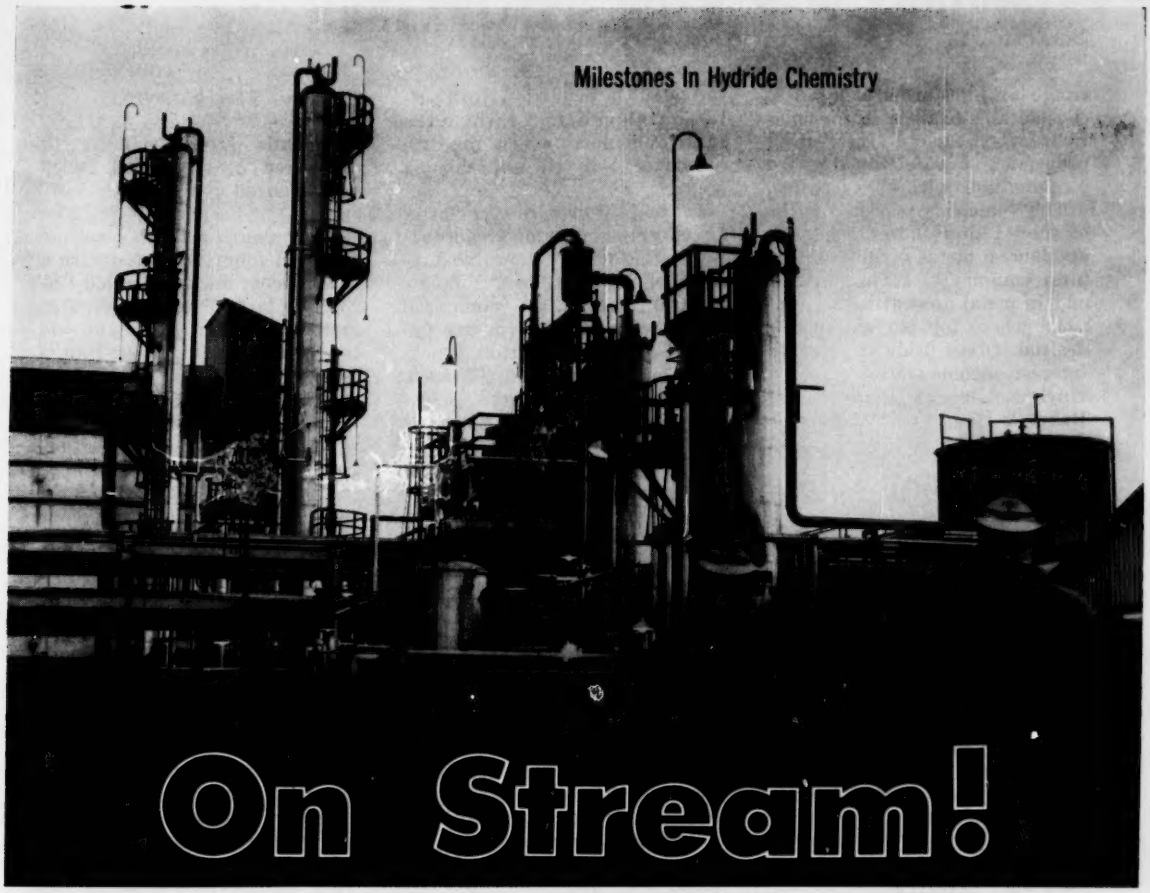
. . . With Improved Thermoset

Baked Film Properties	New Thermoset Via New Vehicle	Competitive Acrylic Thermoset
Initial solids	56.6	56.3
Tukon hardness	27.2	21.2
Knife adhesion	Very good	Excellent
Gloss, Photovolt	93	85
Flexibility	Very fine cracking	No cracking
ASTM Blister ratings		
200 hr., 1% Tide, 165 F.		
Unprimed Bonderite	Excellent	Very poor
Primed Bonderite	Very few	Few

Acryloid AT-50, the new thermosetting acrylic polymer in organic solvent, cures at standard baking temperatures to extremely hard, glossy films. They're said to possess superior resistance to soap, detergents and straining. By virtue of its high degree of cross-linking, films develop excellent solvent resistance, resistance to printing and to deformation at elevated temperatures.

Application properties of a white enamel formulation containing AT-50 are compared above with those of one of the commercial thermosetting acrylic enamels. Laboratory tests show even more marked advantages over premium alkyd baking enamels.

Its compatibility with a wide



New MHI Sodium Borohydride SWS*
lowest cost borohydride available

*SWS—Stabilized Water Solution!

A new low cost form of sodium borohydride is now available in large commercial quantities from Metal Hydrides Incorporated. In this new form, the **contained** sodium borohydride is priced at less than half that of the pure material. MHI Sodium Borohydride-SWS is a stable, aqueous caustic solution of sodium borohydride. The sodium borohydride content is about 12 weight per cent. This should be good news for chemical processes waiting for a lower cost borohydride product.

MHI Sodium Borohydride-SWS is an effective agent for the reduction of carbonyl groups to alcohols. With most aldehydes and all ketones tested, good yields of alcohols resulted. The reduction reaction of aldehydes takes place faster than condensation or polymerization reactions which might be expected in the presence of strong caustic. This means that MHI Sodium Borohydride-SWS can be used to clean up small amounts of carbonyl and peroxides in organic products.

MHI Borohydride-SWS will also react with many inorganic ions, as does the pure borohydride, without interference from the caustic.

Other suggested uses for MHI Sodium Borohydride-SWS include foaming plastics and silicates; bleaching and stabilizing wood pulps; and treating natural and synthetic textiles.

Easy and safe to handle and use in standard equipment, new MHI Sodium Borohydride-SWS merits your attention. Write for complete information and order your trial quantities now!

CHEMICAL HYDRIDES DIVISION
Metal Hydrides Incorporated
PIONEERS IN HYDROGEN COMPOUNDS
713W CONGRESS STREET, BEVERLY, MASSACHUSETTS

range of film-formers provides considerable latitute in formulation. Particularly interesting properties are obtained with combinations with epoxy resins.

The vehicle is expected to be of special interest in finishes for appliances, metal furniture, hospital equipment, stoves, drums, and in metal decorating applications where top performance is desired. Other fields of potential interest include paper coatings, vinyl plastisols and organosols.—**Rohm & Haas Co., Washington Sq., Philadelphia.** **96A**

Fatty Amines

Based on tall oil, they show promise in processing chemicals, ores.

Three new fatty amines are expected to find application in ore flotation, as reagents for chemical processing, and in the preparation of asphalt emulsions for paving roads. Other potential fields of application include synthetic resins, printing inks, protective coatings, and floor coverings.

One product, Delamin P, results from processing the fatty acid portion of tall oil. Another, Delamin PD, is the high-purity distilled form, while the third new amine, Delamin X is a mixed resin-fatty amine corresponding to the processing of whole tall oil.

Development work in the company's flotation laboratories has shown that Delamin X has excellent potentialities in the flotation of phosphate ore. Delamin X offers economies over presently used reagents, and is now being evaluated by the leading producers of phosphate fertilizers.—**Hercules Powder Co., Wilmington, Del.** **98A**

Grease

Boasts long life, heat stability, quick set.

Witco Chemical has been granted U. S. Patent 2,859,179 covering a grease composed of lubricating oil and, as thickening agent, a metallic soap (preferably aluminum) of which the fatty acid portion is a mixture of monocarboxylic and sebacic acids.

In testing-machine performance, grease produced according to this patent shows no substantial breakdown below 100,000 strokes, as compared with the usual performance figure of 5,000. In addition, it sets more quickly and remains stable at higher temperature.

Other advantages include lower soap-content requirements and greater stiffness without deterioration of grease structure.

The sebacic acid content of the metallic soap component may normally vary from 5-20%. The amount of soap used depends on the grease stiffness required, but a 6% concentration usually assures satisfactory results.

The soap specified in the patent is covered by Witco Patent 2,699,428 and licenses to produce it are available upon request. The company will also license any manufacturer to use procedures outlined in Patent 2,859,179. Manufacturers that purchase soap made by Patent 2,699,428 from Witco or its licensees may market grease without royalties.—**Witco Chemical Co., New York.** **98B**

Epoxy Tie Coating

Bonds fresh concrete to cured concrete and cured to cured concrete.

After pouring fresh concrete on cured concrete coated with a new tie-coat material called PR-930, the latter chemically cures to a tough film. New and old concrete bond together into a single unit eliminating the necessity of chipping and roughening the cured concrete which would obtain an inferior mechanical bond.

The new tie-coat is a fluid, two-part, modified epoxy compound which can be easily mixed and applied by brush, roller or spray to damp or dry concrete.

It can also be used to bond cured concrete to cured concrete. When properly applied, the strength of the bonded area exceeds the tensile strength of the concrete.

According to the manufacturer, the product is unaffected by acid or solvent conditions, is not limited to mild weather conditions, can withstand severe temperature changes, and is unsurpassed in durability, strength and economy.

PR-930 may also be used as a nonstructural adhesive for bonding fresh or cured concrete

Newsworthy Chemicals

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Grease boasts long life, heat stability, quick set.....98B
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Porous glass filters corrosive fluids.....100A
Polyester resin is unusual chemically and property-wise.100B
Textile finish repels both water and oil.....100C
Vulcanizing fluoroelastomer bonds hard-to-bond rubbers.100D
Barium-cadmium complex ups vinyl's light stability.....100E
Ammonium thioglycolate for permanent creases in pants.100F
Odorless household bleach now in commercial production.100G
Nonionic coning oils of light color for textured yarns...100H
Flame resistant resin added to polyolefin line.....100I

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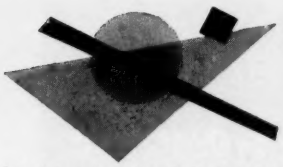


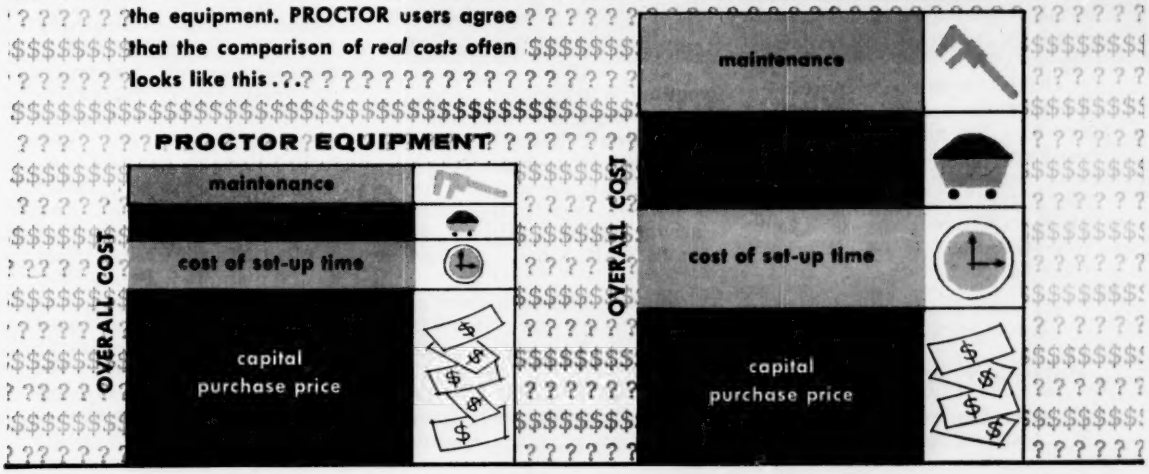
MODERNIZING WITH NEW EQUIPMENT?

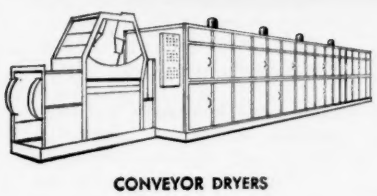
what will the REAL cost be?

REAL COST =

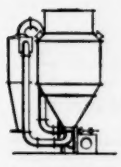
CAPITAL COST
INSTALLATION COST
AVOIDABLE WASTE
MAINTENANCE
DELAYED PRODUCTION

The purchase price can be the least of these over the years you will operate the equipment. PROCTOR users agree that the comparison of *real costs* often looks like this . . .

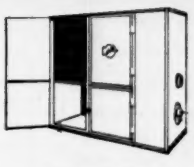




CONVEYOR DRYERS



SPRAY DRYERS



TRAY DRYERS

TRUCK DRYERS

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to aluminum, steel or wood.—**Products Research Co., Los Angeles, Calif.** 98C

Porous Glass

For filtering corrosive fluids, for gas diffusion and for purification.

Industrial filter assemblies using a mechanically-strong, corrosion-proof porous material has been developed. The units are designed for filtration of corrosive and other fluids and are ideally suited for gas diffusion and purification.

The filters themselves are made of a porous material of uniform structure, giving the material a high particle retention rating. For example, a filter rated at 50 microns will, through controlled porosity, retain 98% of all particles larger than 50 microns.

The material is nonsloughing, eliminating the problem of shedding and passing of filter body particles. It will withstand continuous firing at 1,000 F. for an indefinite time without changing structure.

The filters are said to resist all corrosives, except hydrofluoric and hot alkalis. Mechanically strong, the material can be used under high pressures. Density is 1.95. Modulus of rupture at room temperature is 3,230 psi.—**Corning Glass Works, Corning, N. Y.** 100A

Polyester Resin

For fabricating chemical-resistant tanks, ducts.

A polyester resin with certain end-use characteristics approaching those of epoxies has been developed in liquid form. Called Atlac L-382-13, it offers advantages in the fabrication of chemical-resistant tanks and applications in textile and pulp and paper equipment, where corrosion may be a factor.

Based on a bisphenol derivative reacted with fumaric or maleic anhydride, the resin is different from other available polyester resins both in chemical composition and use characteristics. Its special properties become important in applications where conditions such as elevated temperature or corrosion cause physical, chemical or electrical failure in normal polyesters. In such cases, it could eliminate the need for more costly epoxy materials.

The product offers superior resistance to water, acids and alkalis, particularly at elevated temperatures. Its heat distortion temperature (285 F.) is higher than that of conventional polyesters. As a result, parts will retain a greater proportion of initial strength at elevated temperatures. Excellent hot-strength will facilitate part removal from the mold.

It has excellent electrical properties, particularly after exposure to high humidity conditions. It lacks styrene after-odor, an important consideration when parts are used for consumer or food items.—**Atlas Powder Co., Wilmington, Del.** 100B

BRIEFS

Repelling water stains as well as oil stains and dry soil, a new textile finish is aimed primarily at washable fabrics but is effective on the dry-cleanable variety too.—**Minnesota Mining & Mfg. Co., St. Paul, Minn.** 100C

Vulcanizing fluoroelastomer cement for bonding Viton (Du Pont's high-temperature fluorelastomer) to Viton is known as C-328 RTV. Used at ordinary room temperature it consists of (1) a solution of Viton containing about 35% solids and 65% solvent and (2) a nonvolatile room temperature vulcanizing catalyst. It can also bond Viton to metal.—**Connecticut Hard Rubber Co., New Haven, Conn.** 100D

Barium-cadmium complex stabilizer, Nuostabe V-134, is said to impart superior heat and light stability and sheet color to various types of vinyl formulations. It is primarily for use in calendering, plastisol, organosol, extrusion, injection molding and solution formulations.—**Heyden Newport Chemical Corp., New York.** 100E

Ammonium thioglycolate solution which makes permanent creases in pants is now being marketed under the trade name Siroset. The chemical acts on wool or silk and creases cannot be removed with any solvent except ammonium thio itself.—**E. Merck A.G., Darmstadt, Germany.** 100F

Odorless household bleaching agent, Oxone monopersulfate compound, is now in commercial production. It reacts readily with soil-containing elements and natural color bodies to form colorless compounds which are then rinsed off the fabric. It will not affect wash-fast colors in dyed or printed fabrics.—**Du Pont Co., Wilmington, Del.** 100G

Three nonionic coning oils, used primarily for textured yarns and nylon filament yarn for hosiery knitting, are now being introduced. Known as Textilines, they are extremely light colored oils, exceptionally stable to oxidation and discoloration with a built-in static inhibitor.—**L. Sonneborn Sons, New York.** 100H

Flame resistant resin has been added to the Fortiflex A series of linear polyolefin plastic materials. Among the potential uses: appliance parts, junction boxes and other electrical uses.—**Celanese Corp. of America, New York.** 100I

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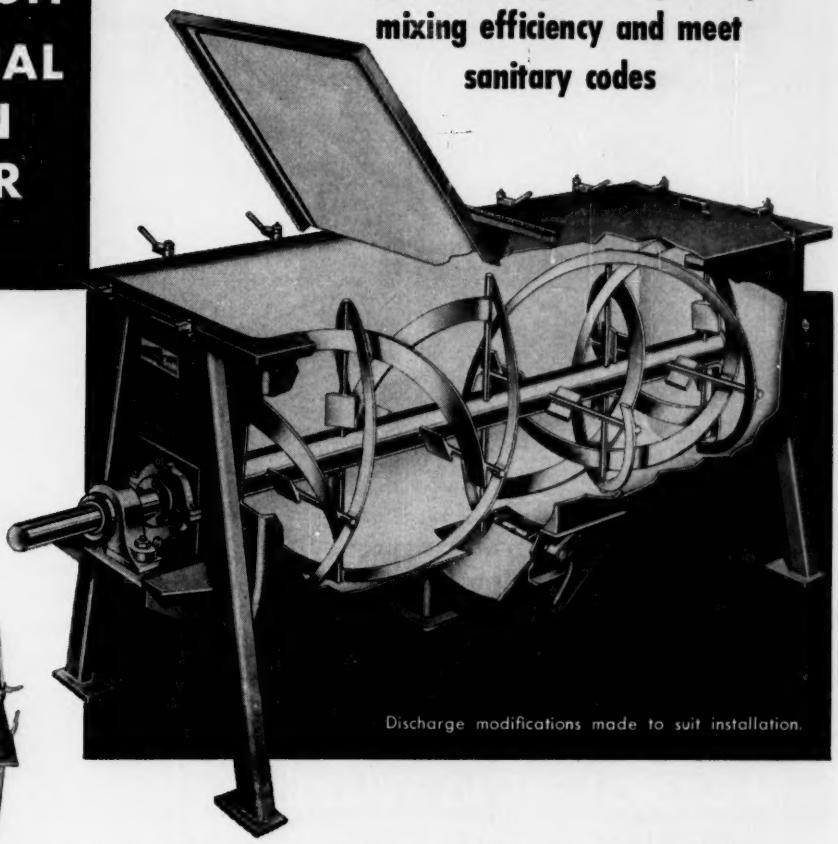
NEW...

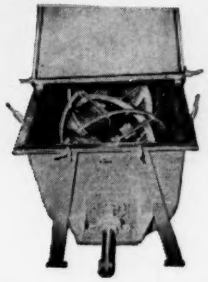
STRONG-SCOTT INDUSTRIAL RIBBON BLENDER

Specially designed to give top mixing efficiency and meet sanitary codes



Discharge modifications made to suit installation.

Rounded tub ends prevent material hang-up, neoprene cover-seals provide dust-tight fitting.



- Swing or slide-type discharge gate, curved to eliminate dead pocket.
- Unique coupling permits vertical removal of agitator assembly without disturbing shaft ends and bearings.
- Heavy-duty, outboard anti-friction bearings.
- Air-purge, lip seal or stuffing box seals readily removed for quick cleaning.
- Dust-tight covers, with quick-action clamps.

Top mixing efficiency with the new Strong-Scott Ribbon Blender mixer on dry or semi-dry materials, has been proven through continuous testing. The Ribbon Blender also meets requirements of health codes where necessary.

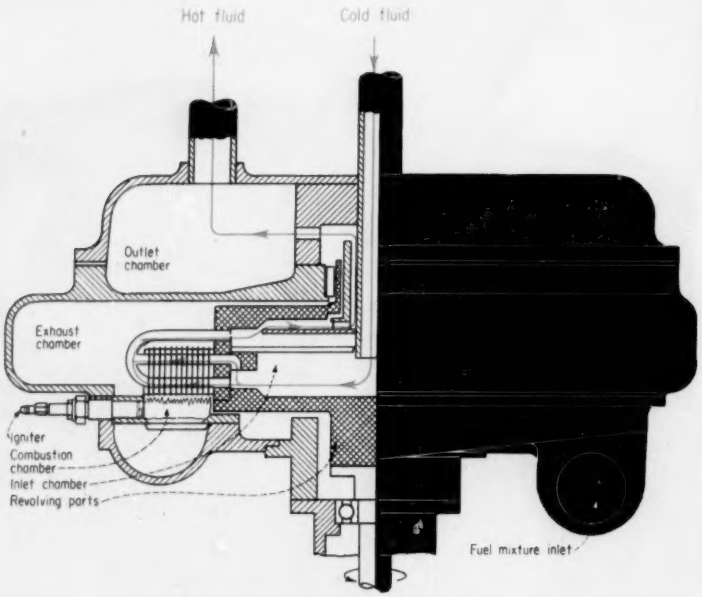
The ability to thoroughly and quickly mix is provided by a unique "ribbon assembly." The smallest amount of additives are thoroughly mixed in a matter of minutes. Special smooth-surface, cornerless welding and rounded corners throughout, leave no place for material to gather. The cover is seal-tight for maximum cleanliness and dust control.

Nine different size units ranging from 16 to 300 cubic feet working capacity are available in stainless steel or carbon steel. Jackets for heat transfer mediums also available.

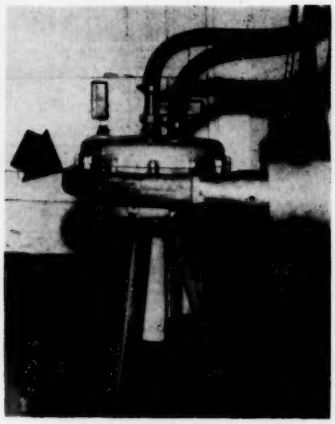
PLAN '59 *Modernize now for growth and profits*

The Strong Scott Mfg. Co.

451 Taft Street N. E., Minneapolis 13, Minnesota



Turb-O-Heat exchanger illustrated above as fluid heater



Heat Exchanger Spins Way to High Flux

In this novel unit, rotation of the "tube bundle" boosts heat-transfer rates and minimizes scaling. Applications may include heating, cooling, condensation and steam generation.

Turb-O-Heat, a versatile new heat-exchange mechanism, crams heat transfer rates of 300,000 Btu./hr. into a tidy package only 20x20x30 in. Key to this capability is utilization of centrifugal force as an aid to heat transfer.

Briefly, Turb-O-Heat consists of a motor-driven, finned-tube rotor mounted on a vertical axis within a horizontal, cylindrical casing. Compared with a conventional shell-and-tube exchanger, the rotor is equivalent to the tube bundle, the casing is the shell.

▶**Tubeside Operation**—In steam-generation service, cold water enters the spinning rotor's inlet chamber. Centrifugal force throws the water toward the U-bends of the hot tubes, thus displacing the lighter heated water. The hot water rises past a partition wall and flows into an outlet chamber where it flashes to steam.

Because of centrifugal force, the pressure in the tubes is greater than that in the inlet and outlet chambers. Resulting pressure differential suppresses boiling in the tubes. Centrifugal force also main-

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tains high fluid circulation rates. Combined, these effects assure high heat-transfer rates and minimum scaling.

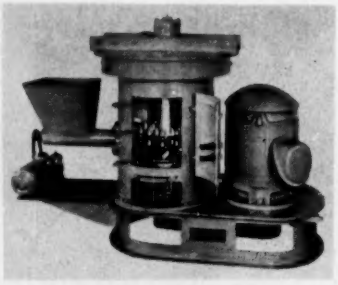
▶**Shellside Operation**—High-speed rotation (3,600 rpm.) of the finned rotor assembly sucks premixed fuel (gas or oil) and air through the ports of a burner plate into an annular combustion chamber. An igniter starts combustion, and the hot gases pass through the spaces between the tube fins, giving up their heat.

Gases then exhaust through a spiral-shaped flue at high velocity. High turbulence induced by the spinning rotor promotes good heat transfer between combustion products and the finned tubes.

▶**Possible Applications**—As a steam generator, the Turb-O-Heat can continuously convert cold feedwater to 100-psig. steam—within 15 sec. from startup.

Or, with minor modifications, the unit may find use in process heating, cooling or condensation operations.

Weighing only 150 lb., Turb-O-Heat is easy to install and service. It can be mounted on wall or floor or attached directly to process equipment. Cost is about $1,000.—**Turb-O-Heat, Inc., Brooklyn, N. Y. 102A**



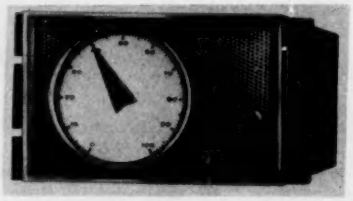
Hammer Mill

Yields large quantities of finely ground product.

Sturtevant has just unveiled the Pulver-Mill, a vertical hammer mill having an integral air classifier. Unit output is up to 5,000 lb./hr. of extremely fine-ground product when feeding on soft, nonmetallic materials.

In operation, raw material passes through a variable-rate screw feeder, and is pulled into the pulverizer zone by vane-induced air flow. Rigid revolving hammers impact the material against stationary and housing walls. An exhaust fan pulls pulverized fines upward through a revolving centrifugal selector. Only particles of desired fineness are blown to the collector.

Refrigerated gas may be introduced during grinding of heat-sensitive materials. For materials having a tendency to adhere to steel, the Pulver-Mill may be lined with rubber—**Sturtevant Mill Co., Dorchester, Mass. 104A**



Flow Indicator

Transistorized unit has new look, low cost.

A transistorized, servo-driven, flow-rate indicator for Fischer & Porter magnetic flowmeters costs only about one-quarter as much as previously available indicators. Accuracy of the a.c. null-balance instrument is ±2% of full scale; repeatability is ±1%.

Readings are prominently displayed by a red pointer on a 4½-in. concentric dial. The dial calibrates for percent or direct reading. Instrument weight is only 15 lb.—**Fischer & Porter Co., Hatboro, Pa. 104B**

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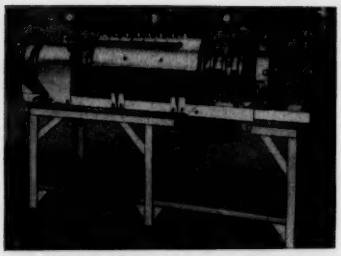


Experimental Calciner

Pilot-plant and research unit heats and cools.

In a new, continuous, rotary combination calciner and cooler scaled down to research size, materials can be heated to a maximum of about 2,000 F., and cooled to the range of 150 to 200 F. before discharge.

Material from a stainless steel feed hopper moves via a manual or motor-driven screw feeder into the cast alloy retort tube. The tube is chain-driven at speeds ranging from 1 to 13 rpm. by a ¼-hp. motor. Slope may be varied to control time of passage of feed through the retort. All models can be either fuel-fired or electrically heated. —**The C. O. Bartlett & Snow Co., Cleveland, Ohio. 104C**

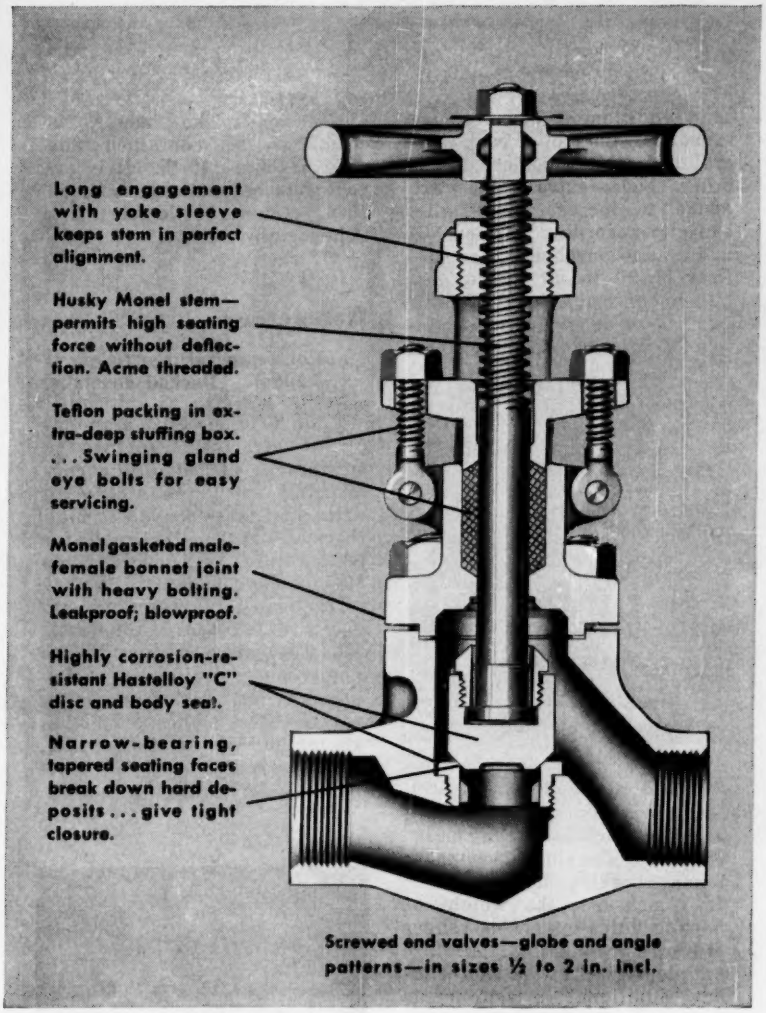
Computer

Ups efficiency and insures chromatography accuracy.

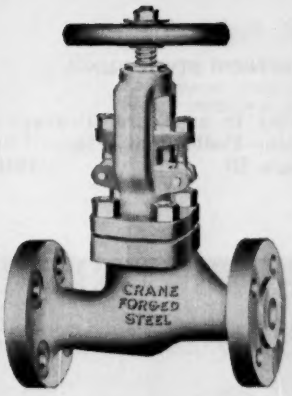
According to the manufacturer, the new Computagram will increase efficiency and insure accuracy of gas chromatograhic analyses. An analog computer, the unit makes it possible to calculate a complete analysis in less than 3 min. Calculated percentages are accurate to within 0.1%.

In operation, the computer corrects peak areas or peak heights for differences in the response of the detector, and normalizes the corrected areas or heights to total 100, thereby giving percent of each individual component.

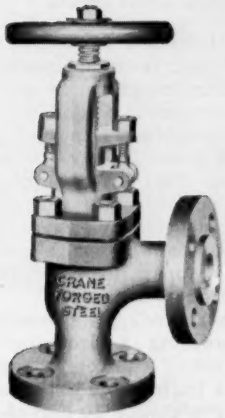
Three models are available, one each for 4, 8, or 12 components. While recommended for use with the manufacturer's Chromacon chromatograph, Computagrams are appli-


Long engagement with yoke sleeve keeps stem in perfect alignment.
Husky Monel stem—permits high seating force without deflection. Acme threaded.
Teflon packing in extra-deep stuffing box. ... Swinging gland eye bolts for easy servicing.
Monel gasketed male-female bonnet joint with heavy bolting. Leakproof; blowproof.
Highly corrosion-resistant Hastelloy "C" disc and body seat.
Narrow-bearing, tapered seating faces break down hard deposits ... give tight closure.

Screwed end valves—globe and angle patterns—in sizes ½ to 2 in. incl.



Flanged end globe valve—in sizes ½ to 6 in. incl.



Flanged end angle valve—in sizes ½ to 2 in. incl.

NEW! Crane chlorine valves now in sizes up to 6 in.

Performance-proved over many years in sizes up to 2 in., these *engineered-for-chlorine* valves are now available in larger sizes with flanged ends—2½, 3, 4 and 6 in.

Many features put these valves head and shoulders above any other for gas or liquid chlorine handling. There's extra strength where needed in the steel body and integral bonnet and yoke. The bonnet joint is gasketed with Monel and heavily bolted; it's leakproof and blowproof. A deep stuffing box with Teflon V-ring packing insures long-life stem seal.

Disc and body seat ring are Hastelloy "C" for tight seating with high corrosion resistance. Narrow-bearing, 45-degree taper seating design and the husky Monel stem easily break down any hard deposits on seat faces.

Choose these valves for all water-free chlorine gas or liquid services up to 300 F. They're ideal for chlorinating lines in chemical processing and bleaching, treatment of water and sewage, etc. Get complete specifications from your Crane Representative or write to address below.

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PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Illinois—Branches and Wholesalers Serving All Areas

cable to any chromatographic unit.—**Podbielniak, Inc., Chicago, Ill.** 104D

Welding Process

Makes welds on extremely thin metal sheets.

Outstanding feature of a new inert-gas, consumable-electrode welding process is the ability to make manual fusion welds in the thickness range of 0.030 to 0.100 in. on all common metals. Called Short-Arc welding, the process is dependent upon a new power supply, selection of proper shielding gas and suitable apparatus for feeding small-diameter wires.

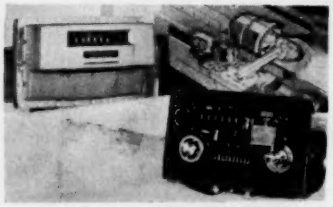
Short-Arc's power supply, incorporating a drooping characteristic, controls surge currents to limit the time duration of arc outages, to prevent wire ejection and to produce a stable buzzing type of arc. When used with 0.030-in. or 0.020-in. wire, the power supply produces a small, cold puddle pinpointing the location of the arc heat and enabling the welding of thin materials in all positions.

Distortion is minimized because of the pinpoint arc, and there is little or no postweld cleaning. Very little training is required for adaptable personnel.—**Linde Co., New York, N. Y.** 106A

Water Conditioner

Priced 30 to 40% below comparative models.

Water-conditioning units for light industry can automatically provide softened water for the same price as manual units, according to the manufacturer. Offered in capacities ranging from 40 to 180 gpm., the conditioners also remove turbidity. Control of each mineral bed is independent of all other beds—extra beds are added to increase the unit's capacity according to need. In addition to purchase price savings of 30 to 40%, the new equipment makes possible salt savings of 40%.—**Water Refining Co., Middletown, Ohio.** 106B



Mass Flowmeter

Gives accurate readings directly in pounds.

Cooperation by General Electric and Black, Sivalls & Bryson, Inc., has resulted in development of a "true mass" flowmeter. The simple, low-maintenance device accurately (± 1%) measures the weight of flowing fluids over wide ranges of flow, pressure, temperature and density. It does this without additional measurements and corrections for these variables.

Flow-rate sensor, located in the fluid stream, consists of two cylindrical elements—an impeller and a stationary turbine. The impeller is driven through a magnetic coupling at a constant speed by a synchronous motor. This action gives twist to the fluid stream, and the fixed turbine straightens the stream. Amount of torque exerted on the turbine while removing the twist is proportional to the mass rate of flow.

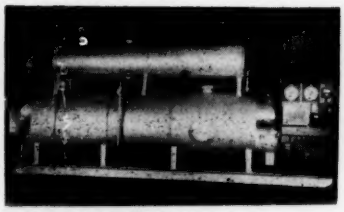
A gyro-mechanism integrates this torque with respect to time, and output is continuously summed up on a cyclometer dial in pounds. The sensing and integrating system can operate from an unregulated power supply without measurable effect on accuracy.

Designed to emit a series of electrical pulses, the flowmeter is also compatible with automation. The meter is completely self-contained, and weighs about 100 lb. It is expected to be available early in 1960.—**General Electric Co., Schenectady, N. Y.** 106C

Refractory

For temperatures to about 3,200 F. Packed as slabs.

Pitco 80, a new 80% alumina-plastic refractory, combines the advantages of monolithic construction with the ability to withstand heavy loads and high thermal shock. Designed for temperatures to 3,200 F., Pitco 80 is recommended to balance refractory linings in high-temperature furnace installations. The gas-tight refractory is also applicable for linings which normally fail under the influence of iron oxides or molten aluminum.—**H. K. Porter Co., Pittsburgh, Pa.** 106D



Liquid Heater

Can replace high-pressure steam heating systems.

A recent addition to the manufacturer's line of process equipment is a low-pressure, high-temperature, liquid-type heater.

Designed to replace high-pressure steam systems, the heating unit consists of a tank-like, oil- or gas-fired furnace in which oil is heated at atmospheric pressure to temperatures ranging from 350 to 650 F. The hot oil is then circulated by a

EQUIPMENT NEWS Continues on . . . Page 198

ONE OF A SERIES

Printed by offset lithography on 80-lb. paper containing Wyandotte PURECAL® in the coating.

When should you call for Wyandotte technical service?

Anytime you need it!

Morning, afternoon, or night.

For, Wyandotte knows that problems involving technical service often won't wait for answers. That's why we have men on duty 'round the clock—qualified men who either know the answers or know where to get them fast!

This 24-hour availability is only one function of Wyandotte technical service.

It also watches over the quality of Wyandotte products—from raw materials to packaging and shipping.

It sees to it that each Wyandotte product you buy will deliver the characteristics and performance you expect.

It provides you with specific recommendations on the use, application, handling, or storing of any of the many chemicals we make.

And it is always available, at your request, to help your scientists on new-product problems in which our products may play a part.

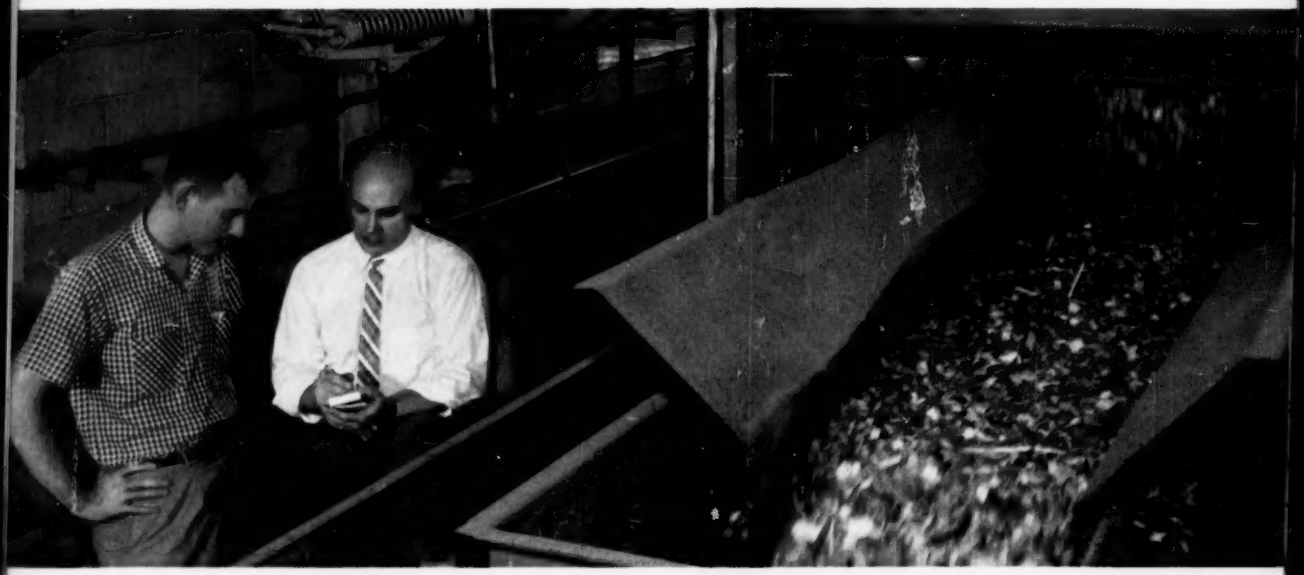
Isn't this a sensible approach to technical service? We think so. And our customers seem to agree!

For a pictorial presentation of Wyandotte technical service at work, please turn page.

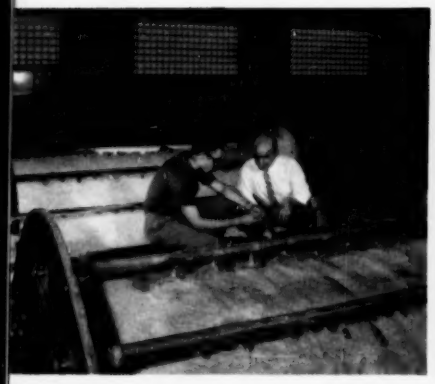
SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE • GLYCOLS
SYNTHETIC DETERGENTS (anionic and nonionic) • SODIUM CMC • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • POLYETHYLENE GLYCOL • PROPYLENE OXIDE
PROPYLENE DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS

Smoothing out problems in papermaking

. . . an example of Wyandotte technical service at work

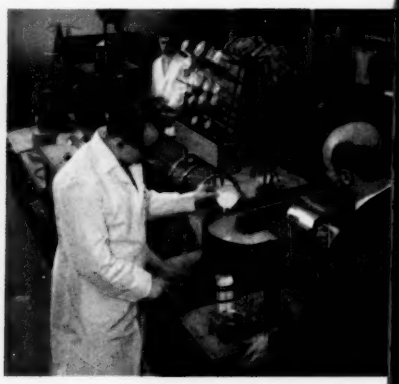


1 Soda ash and caustic soda find wide use in the paper industry for pulping and de-inking. Wyandotte's experience with these chemicals has proved helpful in many ways . . . from handling and storage data to suggested design of manufacturing facilities.



2 Chlorine is another basic chemical for papermakers, finding wide use in bleaching operations. Wyandotte technical service helps in all phases of chlorine handling; sets up safety programs and procedures, and assists in specific bleaching problems.

3 Wyandotte has spent years of research and development in paper coating. Purecal®—Wyandotte's precipitated calcium carbonate—is a widely used coating pigment. Background like this makes us a good source for help on coating problems.



4 New products and applications are studied in our laboratories. Tests here have shown how papermakers can use our Pluronic® polyols for latex stabilization, dewaxing of wax-paper "broke," and as a drainage aid on the Fourdrinier wire of a paper machine.

Wyandotte
CHEMICALS

Pacing Progress with Creative Chemistry

Papermaking is just one area where our technical service can be of help. Our experience extends into many industries: paint, petroleum, chemical, rubber, plastics, to name a few. If you have a problem that falls within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. *Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Michigan. Offices in principal cities.*

726

WIDE OPEN for Fast Wiring and Inspection

NEW complete line of low voltage motor control

Wide-open accessibility and modern design assure fast and easy installation, modification, inspection and maintenance of this new line of Size 0 through 4 Allis-Chalmers control. For instance, large and clearly marked terminals, pressure connections for all wiring, wide and deep-cut screw slots, clearly visible contacts, easy coil replacement, readable rating plates, "out-front" overload relays.

Flexibility

This new line of control permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

Unsurpassed Mechanical and Electrical Life

Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

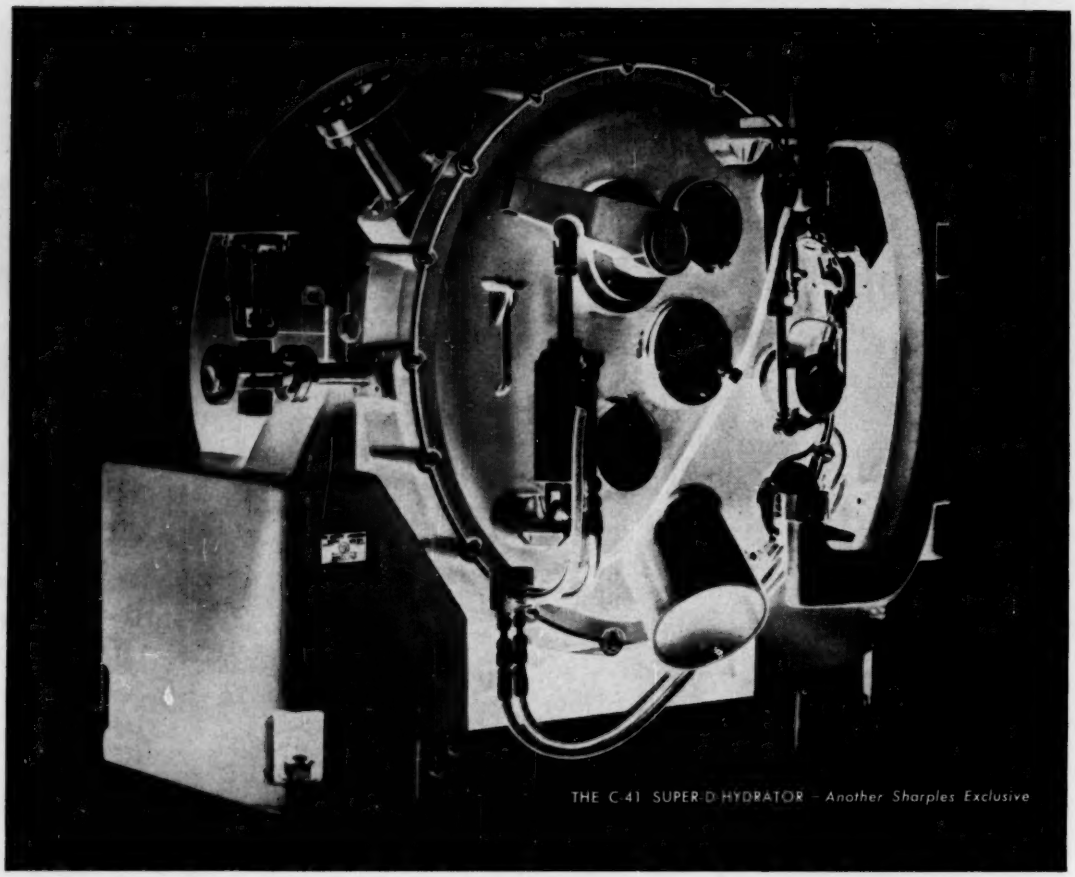
A complete line of low voltage control (Size 0 through 8) and high voltage control *in all NEMA* enclosures, plus engineered control systems. Your A-C distributor or representative will give you all the details. *Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.*

Plan to stay ahead... MODERNIZE!

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5984



"CHEMICAL TREATMENT" *under High Centrifugal Force*

In the dewatering of polyolefin "crystals" it is generally necessary to apply one or two separate rinses to the cake; each rinse liquor being selected carefully to perform a calculated function to insure final high purity of the product.

These rinses, which in effect are carefully controlled chemical treatments, take place under high centrifugal force, and in most cases with the entire "system" pressurized at 10 to 15 psi.

All conditions pertinent to these rinses (duration, frequency, amount and type of rinse liquor, etc.) as well as loading, drying and unloading operations are automatically controlled, and may be adjusted or changed as desired during operation without interrupting production. Capacity of the C-41 Super-D-Hydrator on typical polyolefin dehydrations generally ranges from 2000 lbs/hr. to around 6000 lbs/hr.

Sharples engineers have incorporated many innovations in the design of the new C-41, learned in over 40 years experience in the chemical industry, and are further prepared to give special design consideration to each specific problem. May we consult with you regarding your separation problems?

The new Super-D-Hydrator Bulletin Number 1286 will be sent upon your request.

THE **SHARPLES** CORPORATION

Centrifugal and Process Engineers

2300 WESTMORELAND STREET / PHILADELPHIA 40, PENNSYLVANIA

NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • HOUSTON • SAN FRANCISCO • LOS ANGELES • ST. LOUIS • ATLANTA

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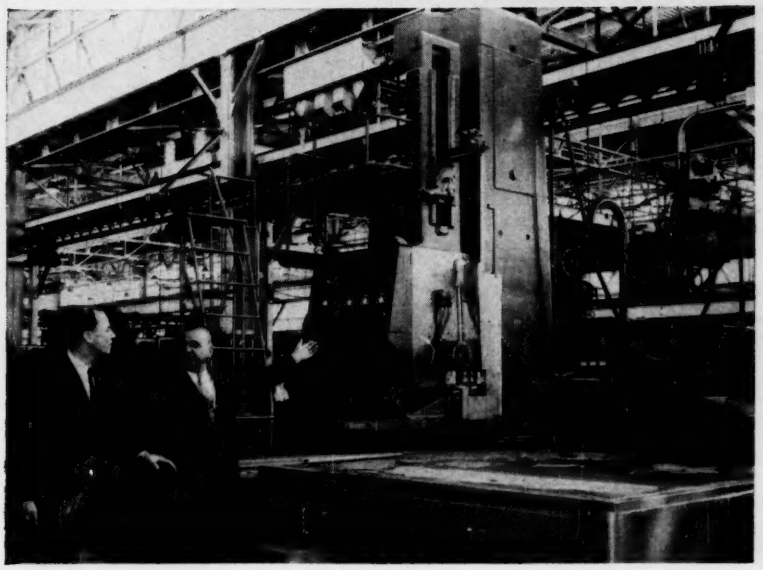
HOW HERCULES HELPS...

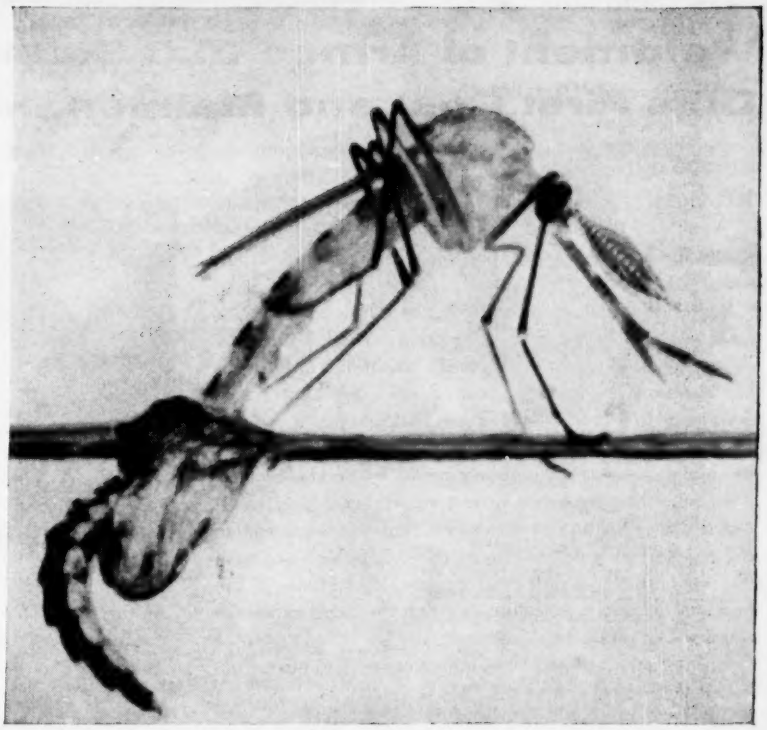


PROTECT HEAVY EQUIPMENT...

This giant Pratt & Whitney die cutter is typical of many applications for Parlon® based chlorinated rubber paints. Parlon finishes dry quickly, are economical to use, and provide a durable coating. Parlon based paint for this application supplied by The Egyptian Lacquer Co.

CONTROL INSECT PESTS...

This dramatic unretouched microphotograph shows a mosquito emerging from the pupa stage. Today this pest and his many companions are no longer the threat to human health and comfort that they once were. Insecticides based on Hercules' materials such as toxaphene and Thanite® (Hercules isobornyl thiocyanoacetate) are sudden death to such insects. In addition, meta-Delphene (Hercules diethyltoluamide) is the base for leading repellents which help to make outdoor summertime activities more enjoyable.

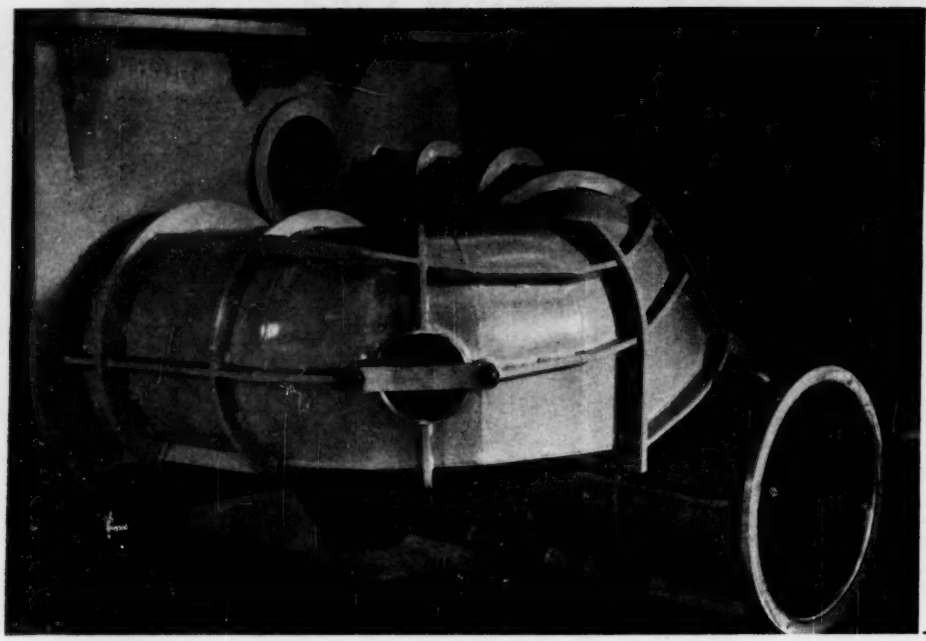


HERCULES

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

CHEMICAL MATERIALS FOR INDUSTRY

Q59-4



Armco 18-12 Mo ELC Stainless cuts cost of this paper mill unit. Compound curves fabricated by welding 11 gage sheet, complicated machining eliminated.

New steels are born at Armco

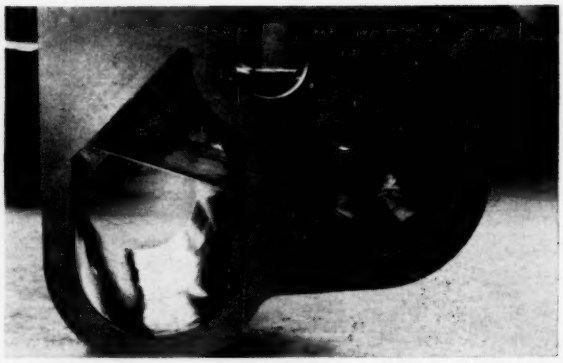
Weldment of Armco ELC Stainless Steel Cuts First Cost and Maintenance Expense

This king-size stock transfer unit for a paper mill, made of Armco 18-12 Mo ELC Stainless (Type 316L) demonstrates the multiple savings possible with extra-low carbon stainless steel.

Replacing a non-ferrous casting, the stainless steel weldment cost considerably less. Smooth, weldable stainless sheets eliminated most of the costly machining and finishing required for the cast part. Besides the appreciable savings in first cost, Armco Type 316L assures continued savings. Its superior corrosion resistance not only means less maintenance cost but more years of dependable service.

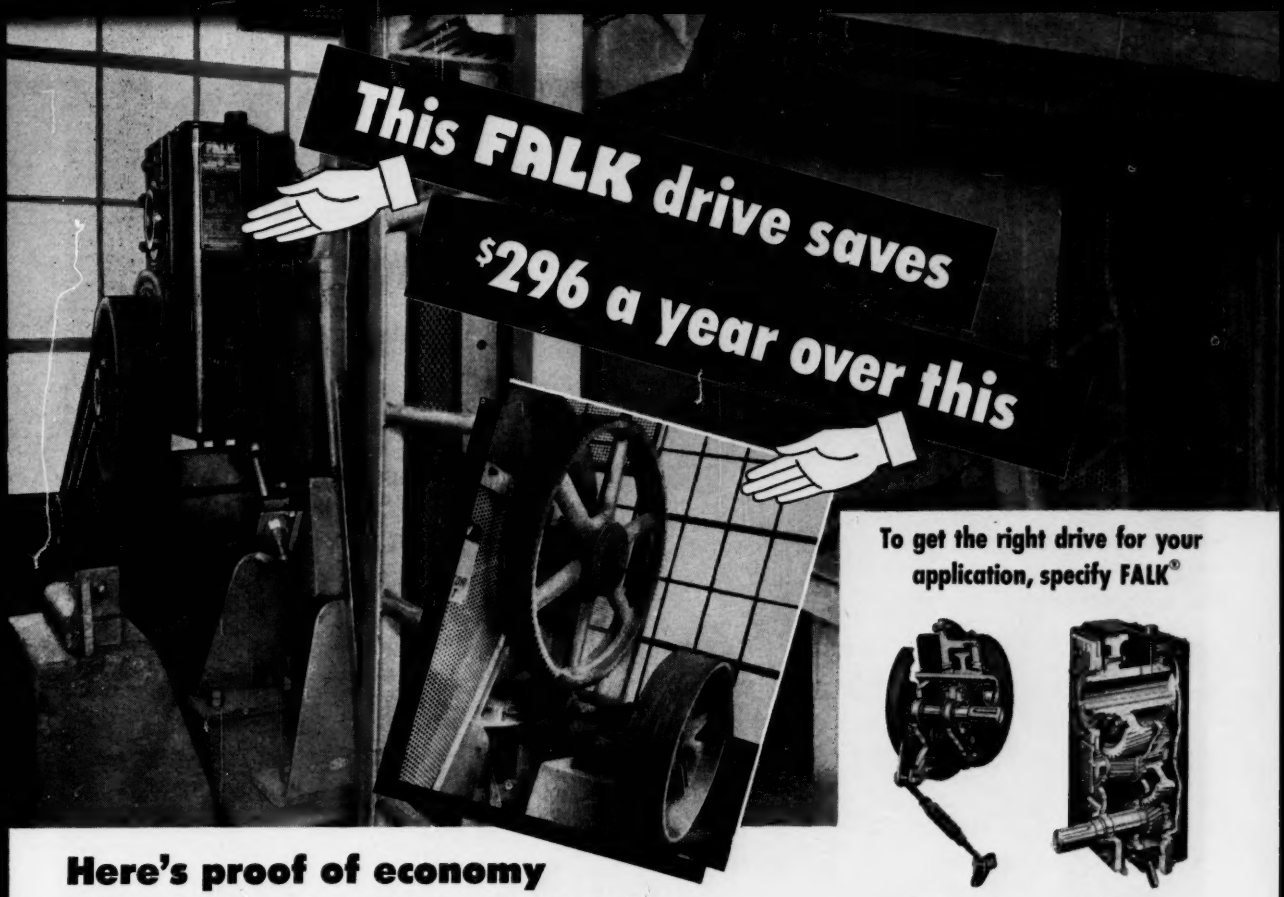
By providing insurance against harmful carbide precipitation due to welding, Armco's ELC Stainless Steels enable the economy of weldments to be effectively combined with the cost cutting durability of stainless. They eliminate the necessity of costly annealing or using the more expensive stabilized grades.

Investigate the possible cost reductions with welded structures made of Armco ELC Stainless Steel. For complete information on these special steels, contact your Armco Stainless Steel Distributor or write Armco Steel Corporation, 2729 Curtis Street, Middletown, Ohio.



ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products



Here's proof of economy with FALK Shaft Mounted Drives

PROBLEM—For many years, a prominent Eastern abrasives manufacturer* experienced high maintenance and down-time costs, as well as excessive noise and vibration, in the operation of 19 pebble mills driven by open spur gears. Drive gears and jack shaft pillow blocks required frequent repairs or replacement, and trunnion shafts often failed, due to radial overloading of the bull gear when broken pinion teeth bottomed between gear teeth.

SOLUTION—After numerous unsuccessful approaches to these problems, the solution was found by mounting a Size 315J FALK Shaft Mounted Drive directly on the mill drive trunnion. This eliminated objectionable gear noise and vibration...greatly reduced costly down-time and loss of production...and cut annual maintenance and replacement expenses as indicated by the following figures taken from the customer's records:

Spur Gear-and-Pinion Drive		FALK Shaft Mounted Drive	
Bull Gears	$ 56	VEE Belts	$ 30
Pinions	120	FALK Shaft Mounted Drive (based on 10-year life)	70
Pillow Blocks	90		
VEE Belts	30		
Trunnion (5-year life)	100		
Annual cost	$396	Annual cost	$100
		ANNUAL SAVINGS	$296

IF OBSOLETE DRIVES ARE COSTING YOU MONEY, a change to Falk All-Steel Shaft Mounted Drives can effect important savings in money and production. Used on almost any type of machine, these compact, rugged units are establishing new standards of economy and efficiency in many industries. Specify FALK Drives on your purchased equipment...For full details, **write for Bulletin 7100.**

*Name on request

THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

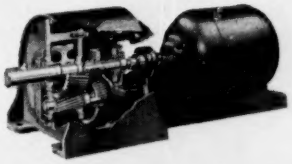
Representatives and Distributors in Most Principal Cities

To get the right drive for your application, specify FALK®

SHAFT MOUNTED DRIVES

Horizontal or vertical units—½ to 50 hp—420 to 5 rpm—single and two double reduction ratios—output torque ratings up to 41,000 lb-in (consult factory for higher torque capacity).

• • •



ALL-MOTOR® MOTOREDUCERS

Sizes up to 75 hp—furnished with or without standard foot-mounted motor—standard output speeds 1.2 to 520 rpm (with 1750 rpm motors)—ratios as high as 54,000:1 in semi-standard designs. Integral units (gearmotor type) also available. Ask for **Bulletin 3100.**

• • •

FALK Drives are available from factory and distributor stocks from coast to coast. Consult your Falk Representative or Distributor.

FALK

...a good name in industry

B-H Blanket Insulation withstands vibration on....

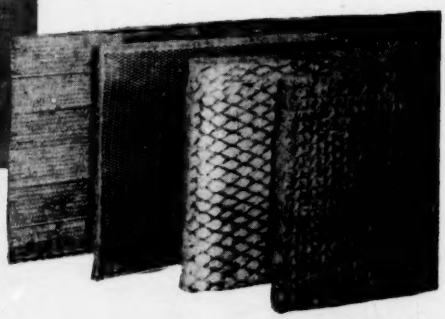
Coke Drum at MOBIL OIL CO. Paulsboro Refinery

Baldwin-Hill Insulating Blankets, because of their dense felting and resilient construction, withstand the vibration set up by drilling and high pressure sluicing during the decoking cycle.

The use of 4 ft and 8 ft lengths permits rapid and efficient covering of large surface areas. This, together with easy application — impaling over welding studs and securing with speed nuts — made this a low cost application.

B-H Blankets, 4 in. thick (effective to 1200°F) easily reduced the outside surface temperature to well below personnel safety limits.

For installation of Baldwin-Hill Blankets and other efficient B-H industrial insulations, request contract application service (available in 48 States) and watch the costs go down.



BALDWIN-HILL

Company

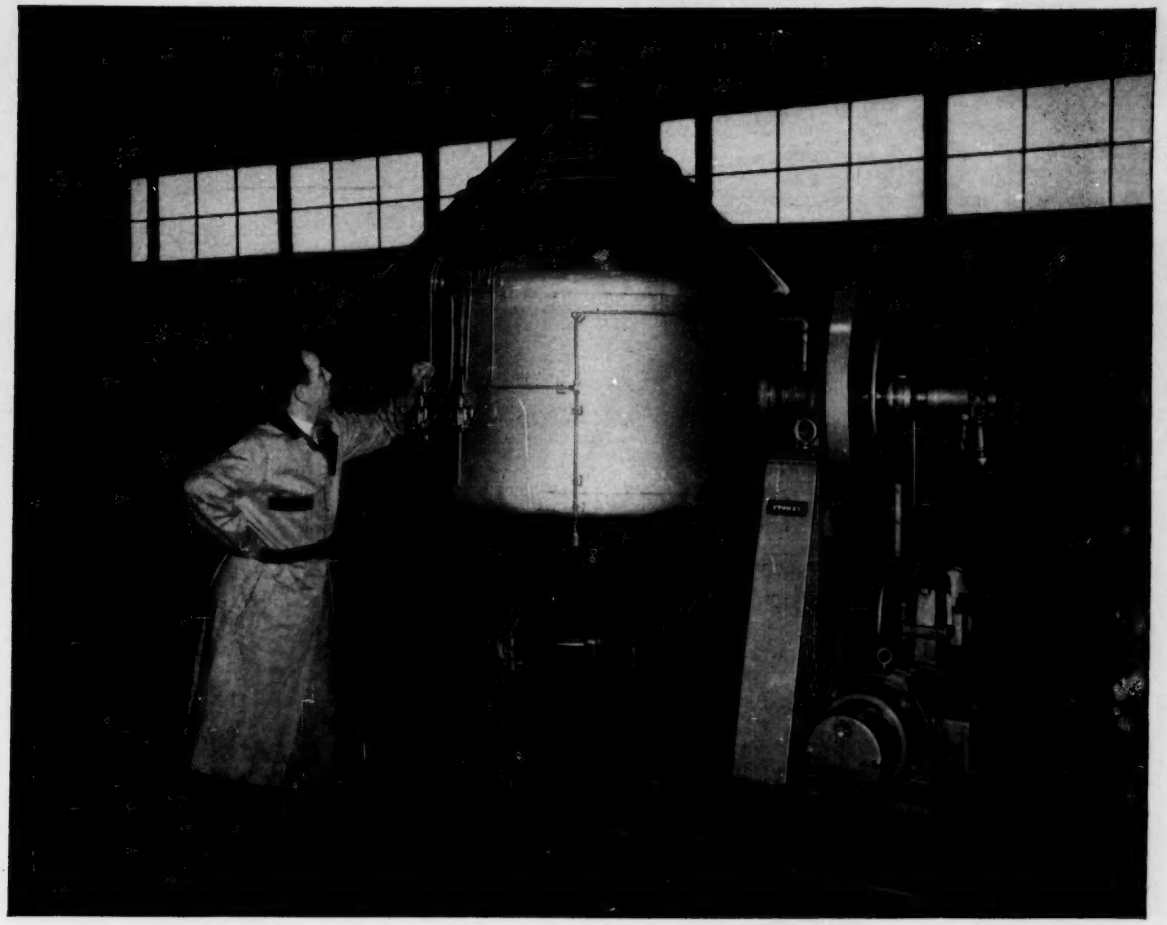
BALDWIN-HILL BH INSULATIONS

CONTRACT APPLICATION SERVICE AVAILABLE

1507 Breunig Ave., Trenton 2, N. J.

Kalamazoo, Mich. . . Huntington, Ind. . . Temple, Tex.

For more information write for catalog or see it in Sweet's Plant Engineering File.



flexibility in a cone...

Stokes Conical Rotating Vacuum Dryers offer unparalleled operational and application flexibility. Proved "in service" design of Stokes vacuum dryers meets requirements of a wide range of products. There is no guesswork in calculating the vaporizing capacity you need or the production rate for a given material. Stokes Dryers are engineered and manufactured specifically for vacuum service . . . and Stokes has been active in the field of vacuum applications for over 40 years.

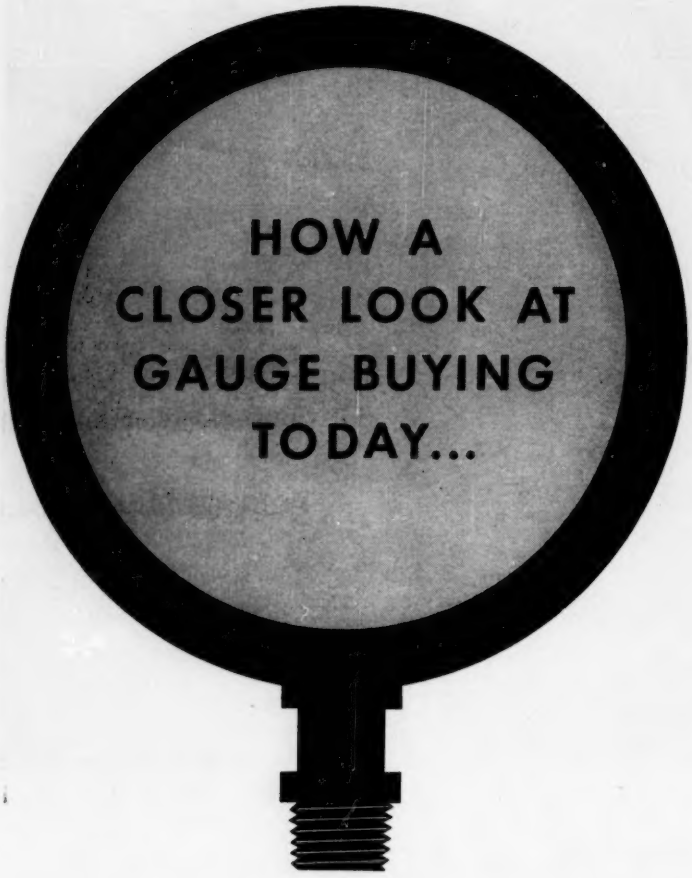
Available in six standard sizes, Stokes Conical Vacuum Dryers have a working capacity ranging from 3 to 150 cubic feet. Special units are built to meet unusual requirements. Every Stokes vacuum dryer features . . .

- **self-wiping vacuum tight valve,** worm-gear actuated, for easy and rapid discharge
- **full-opening hinged cover,** equipped with a quick opening clamp, assures fast loading and minimizes time between batches
- **maximum dust protection,** filter capped to inlet, minimizes need for external collector
- **compact drive assembly**—gear reduction, chain and sprocket drive assembly plus oil tight chain casing
- **double walled construction**—ideal for steam or hot water heating

Stokes vast experience in vacuum drying techniques can be put to work for you. Why not write or call Stokes for details . . . today.

Processing Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

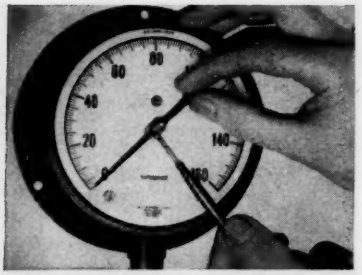
STOKES



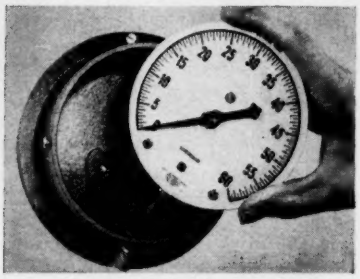
can help cut your gauge maintenance costs

Been taking gauges pretty much for granted? As to the price you pay, accuracy you buy, performance you get . . . gauges you use and their maintenance costs? Maybe it's time for a closer look at the United States Gauge line and how it can streamline buying. USG features the most comprehensive line of indicating dial pressure gauges you can draw on . . . in range of case styles, materials and sizes, in pressure ranges and in price . . . up to the finest gauges money can buy. The *completeness* of the USG line can help you avoid over-buying, under-buying, help you get exactly the gauge performance you pay for . . . from one source! As shown at right, exclusive USG design features even help cut maintenance costs. Check your USG distributor for your next gauge requirement. See the Yellow Pages, or write for catalogs and name of your nearest USG distributor, today.

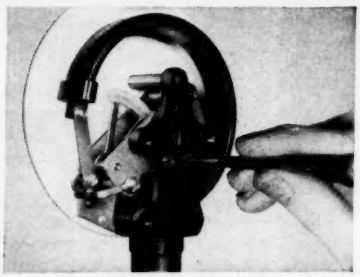
UNITED STATES GAUGE
Division of American Machine and Metals, Inc., Sellersville, Pa.



NOTE that with a USG Supergauge®, complete recalibrations can be made faster than with any other process gauge. For example: "zero shift" adjustments are made from the front with gauge in operating position, and without removing pointer from the shaft.



NOTE that with USG Mono-Unit design, internals are in one assembly which lifts out intact. Legend on dial gives full information for instant identification of model number and materials in components. More maintenance minutes saved!



NOTE that with USG Arc-Loc® movement, corrections for "scale shape" (linearity) errors and "range" adjustments are both made from the rear; no need to remove pointer and dial. USG's unique locking method eliminates creep during locking, saves more time! USG Supergauges meet A.S.A. standards for Grade AA Test Gauges, including accuracy to ½ of 1%. *Write for Catalog 1819.*

SAVINGS IN USG A-LINE, TOO!
Premium gauge construction at savings up to 40% of premium prices! Major economies in pressure measurement where you may now be buying more gauge than you need! Meets A.S.A. Grade A standards, including accuracy of 1%. Wide choice of options. Has Supergauge Mono-Unit design — cuts recalibration time. *Write for Catalog 305.*

The Chemical Engineer snaps 5,000,000 pictures every day

Photographic film, development fluids, light fast dyes, high-purity chemicals, printing paper . . . a few more contributions to enjoyable living by the Chemical Engineer and his technology.

Wherever you find chemical processes in use in industry—and the range is immense, from photographic film to rocket fuels—the chemical engineer is always the common buying-specifying focus. He is responsible for profitable application of the technology that ties this industrial complex into one huge marketplace for equipment, raw materials and services. Sell him first, and you've sold the CPI. And-make sure you keep him sold.

The one sure way of getting your message to this man is through CHEMICAL ENGINEERING—preferred by a 3 to 1 margin among chemical engineers in all functions, in all industries. They get it every other Monday, read from cover to cover. 1958 Starch "Noted" scores were up 11.3%, "Read Most" scores jumped 28.7%, inquiries were 15.5% above 1957's monthly issues. CHEMICAL ENGINEERING, McGraw-Hill Building, New York 36, N. Y.

Published every other monday for Chemical Engineers in all functions

Rocket Man Learns How to put CONTROL in CONTROLLED DISPERSION

A near-discouraged manufacturer of solid rocket fuels used the equipment shown at right to *prove to himself* some principles of blending which often elude processors that are willing to settle for *less* than controlled dispersion.

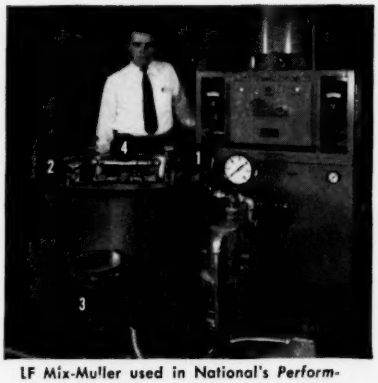
His problem? Unless thoroughly and uniformly mixed, the fuel components would not ignite and burn evenly. Failure here could jeopardize vastly expensive rocket components, cause misfirings and hazardous operating conditions. In addition, the completed mix must be quickly cased or enclosed to reduce hazard.

Mix-Muller handled the second problem quickly and efficiently —because all Mix-Mullers are equipped for fast, *automatic* bottom discharge of the mix.

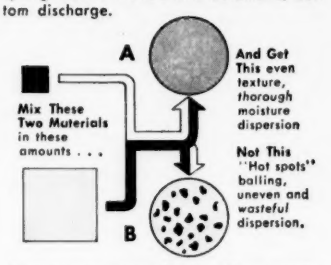
At National's fully equipped *performance laboratory* this manufacturer was able to achieve the desired blend of components through a process of trial and error and elimination of variables. He found Simpson Mix-Muller to be uniquely adaptable for pinpoint control over mixing properties. He found too, that the Simpson Mix-Muller is specifically designed and can be economically equipped for the out-of-the-ordinary mixing jobs which are daily becoming *more* ordinary.

This manufacturer is a satisfied Mix-Muller user today. **You** can purchase the same basic mixer which he is using for as little as $1549.00.* Or, in stainless steel pan and interior, for less than $2995.00.*

Why settle for less-than-perfect blending when you can perfect your *own* controlled dispersion process for less than $1600? *Write for a list* of Mix-Muller users who have done so—on over 100 different mixing applications. And, for the *Handbook on Mulling.*



LF Mix-Muller used in National's *Performance Laboratory* is typical of how a standard Mix-Muller can be equipped for special mixing jobs: (1) Jacket for pressure or vacuum or circulation of heat or coolant (air-tight cover removed); (2) stainless steel interior; (3) explosion proof motor; (4) spring loaded Mullers and automatic, bottom discharge.


A
B
Mix These Two Muterials in these amounts . . .
And Get This even texture, thorough moisture dispersion
Not This "Hot spots" balling, uneven and wasteful dispersion.

Here's how *controlled mulling* works:

Diagram shows comparative results of blending a minute amount of one material with large amount of another material in (A) MIX-MULLER and (B) conventional mixer. Savings in raw material, reprocessing time and quality of finished product are the outstanding *rewards* of mulling your product.

SEE OUR ADVERTISEMENT PAGES 1263-1266 CHEMICAL ENGINEERING CATALOG.

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HOW MULLING gives you controlled dispersion for better blends:

GOING: Mix is wetted, dispersion of coating media begins as lumps form.

GOING: Smearing, *spatulate* action breaks up lumps as mulling action disperses moisture.

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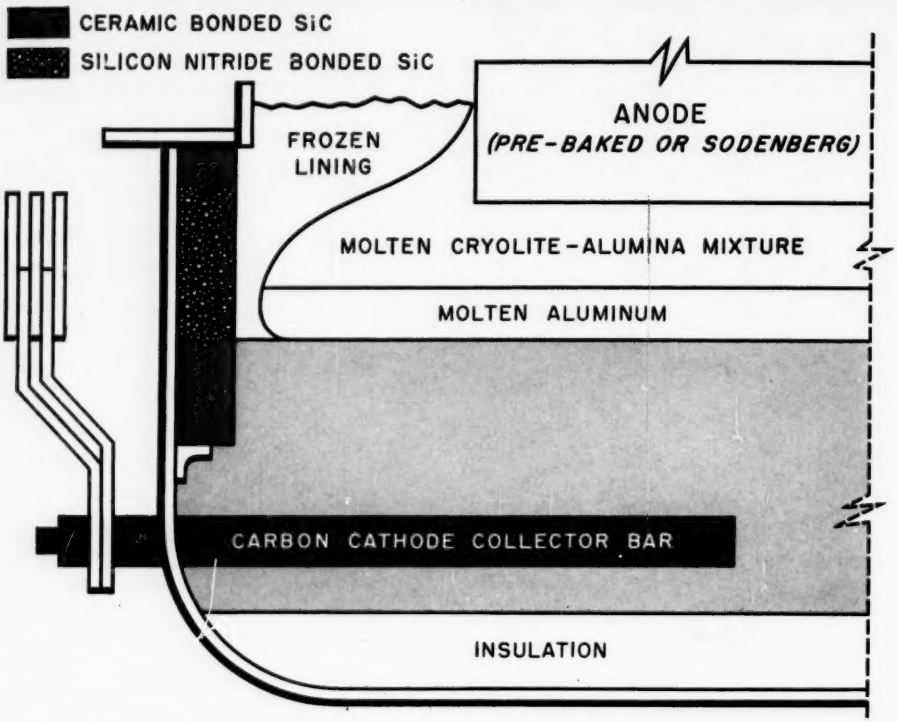
DYNALOG ELECTRONIC INSTRUMENTS

Another industry development with Carborundum's refractories:



Change to silicon carbide linings promises higher output from aluminum reduction cells

Primary aluminum producers are now looking to silicon carbide refractories as a means of lowering costs and increasing output from existing pot lines. Here's how:

Standard electrolytic reduction cells have long used 8 to 13 inch-thick carbon-block linings to resist the action of the molten cryolite electrolyte, which rapidly attacks almost all materials. The use of silicon carbide promises a reduction of lining thickness to as little as 3", resulting in greatly increased cell capacity.

Key to the successful use of silicon carbide is its high thermal conductivity. This not only prevents the side walls from overheating but also protects the lining itself. Heat is conducted away so rapidly that a layer of electrolyte freezes on the lining surface, forming an effective barrier against attack and abrasion.

Experience points to the use of the new silicon-nitride-bonded silicon carbide, which has a particularly high resistance to chemical attack, for the more vulnerable spots, while the lower-cost conventionally bonded product can be used in other areas.

Developments like this show how corrosive melts are frozen on Carborundum's refractory linings to resist high-temperature attack . . . attack that quickly destroys most ceramic materials. If you have such a problem, perhaps one of Carborundum's refractories can give you just the combination of properties you need.

Write today for your free copy of "Super Refractories by Carborundum." The address: Dept. H-79, Refractories Division, Perth Amboy, New Jersey.

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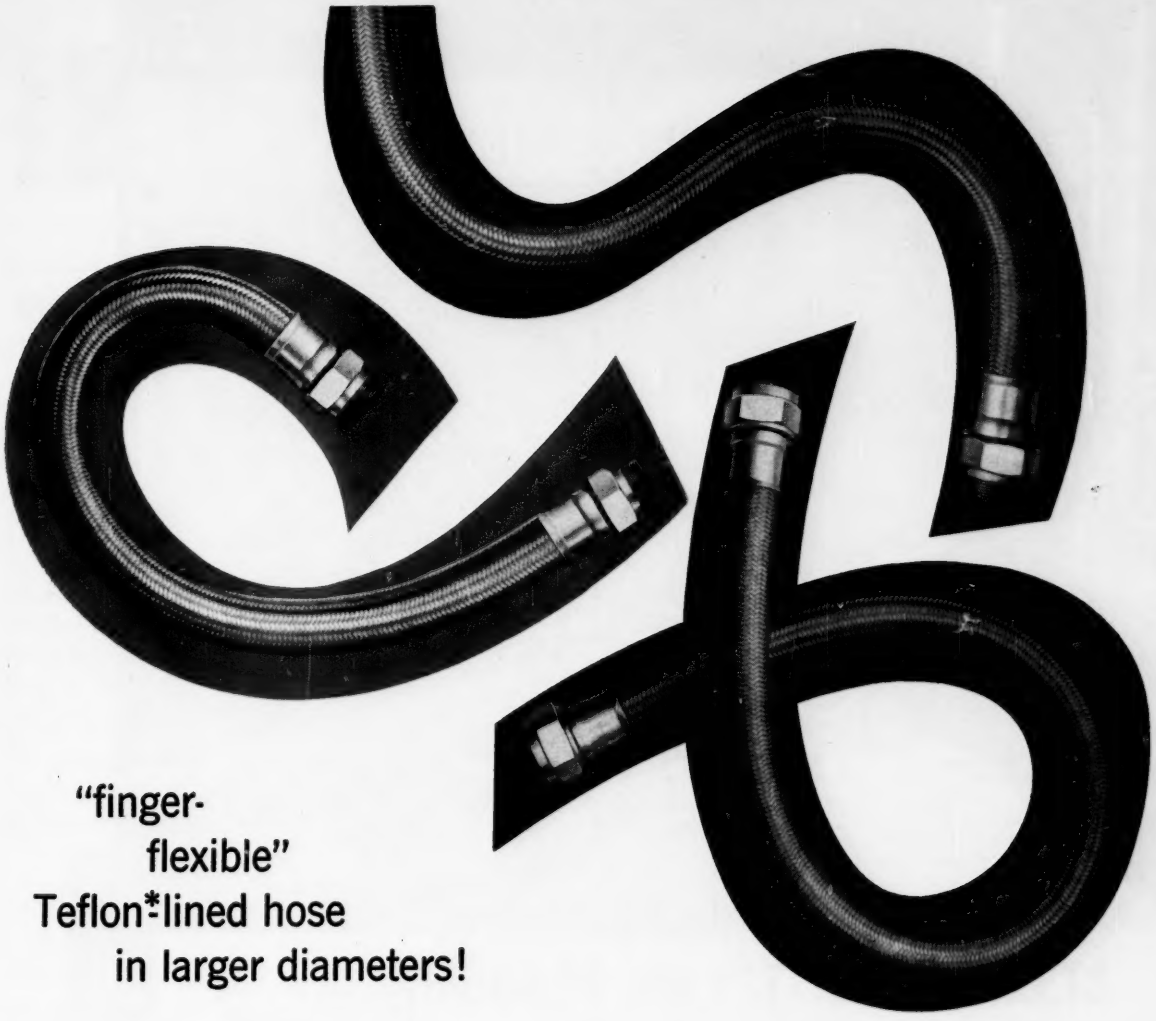

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- Available in lengths to 25 feet (soon to 50!) and diameters of ¾", 1", 1¼", 1½", 2"—and soon—3" and 4".
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- Reinforced with TITEFLEX "zero motion" braiding.
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Already, Springfield "400" is in use for transferring acids, alcohols, methanol and most corrosive fluids . . . for live steam lines . . . for extremely high and low temperature systems. Our data sheets contain answers to your needs. Get a copy from your TITEFLEX distributor or write direct to us. Stocks available at authorized distributors in your area.

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SPRINGFIELD "400" DIMENSIONS AND PERFORMANCE

(Hose assemblies rated for performance at operating pressures shown—through temperature range of −65° to 400° F.)

Nom. Size	"B" Inside Dia.	"A" Outside Dia.	Approx. Weight Lbs/Ft	Min. Bend Radius	PRESSURE, P.S.I. Min. Burst.	Max. Test	Max. Working
¾"	.784	1.067	.34	2½"	2,000	1,000	500
1"	.992	1.262	.40	3½"	2,000	1,000	500
1¼"	1.290	1.555	.50	4"	1,400	700	350
1½"	1.522	1.790	.60	5"	1,000	500	250
2"	1.987	2.315	.94	6¾"	1,000	500	250

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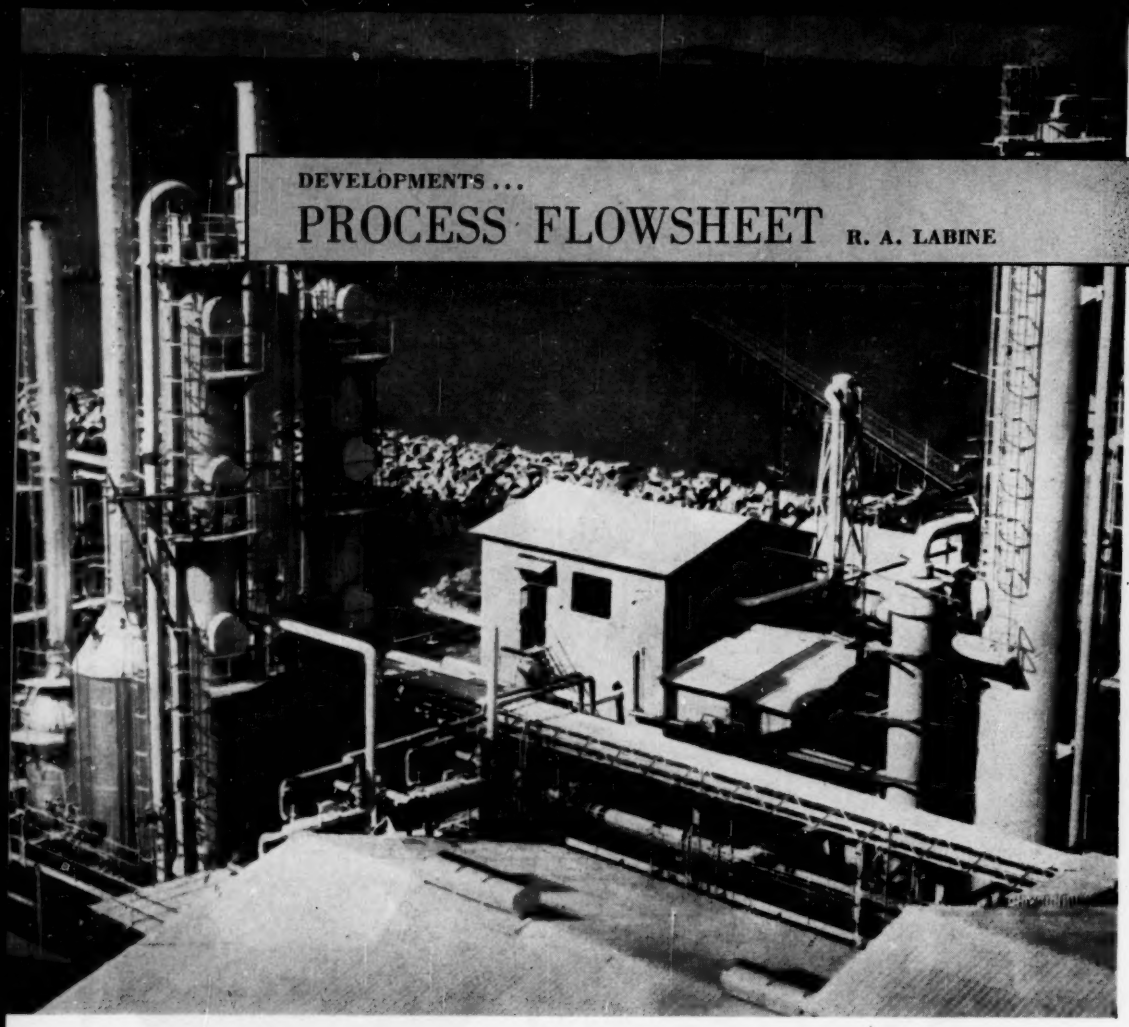


DEVELOPMENTS . . .

PROCESS FLOWSHEET R. A. LABINE

Partial oxidation is basis of

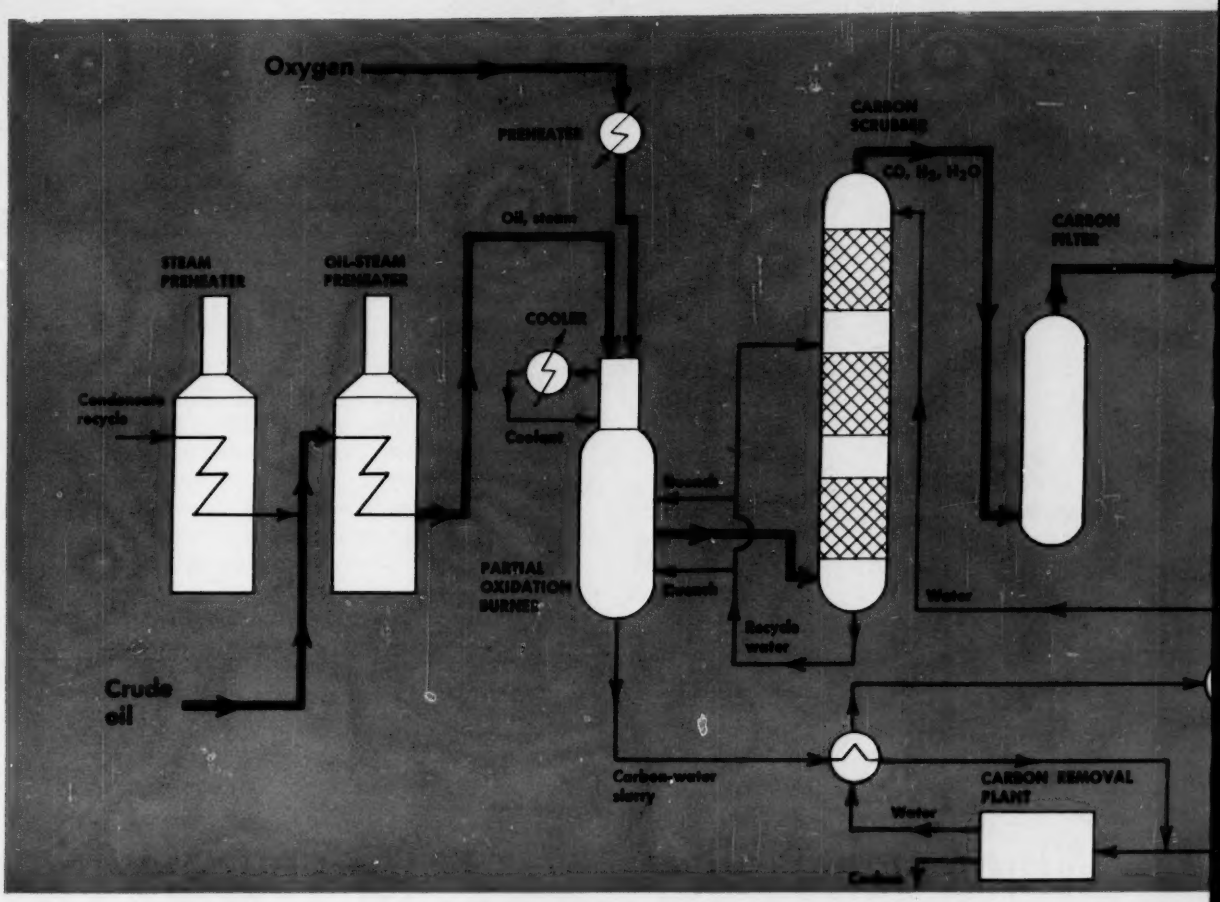
Unique Approach to Process Hydrogen

Designer of a hydrogen-from-crude-oil plant must cope with some sticky carbon problems. Here's one successful operating process.

Now on stream near Kobe, Japan, is a brand new 100 metric-ton/day ammonia plant designed and engineered for Befu Chemical Co. by Chemical Construction Corp., New York. The reason that this plant is noteworthy is the fact that its major raw material is crude oil—just as it comes from the ground in the Middle East—and the fact that it came on stream rapidly with a minimum of startup headaches. Several engineering innovations sidestepped the carbon problems which have plagued previous oil-based partial oxidation plants and are given credit for the ease of plant startup.

► **Enter Partial Oxidation**—Easily one of the most

Unfold Flowsheet



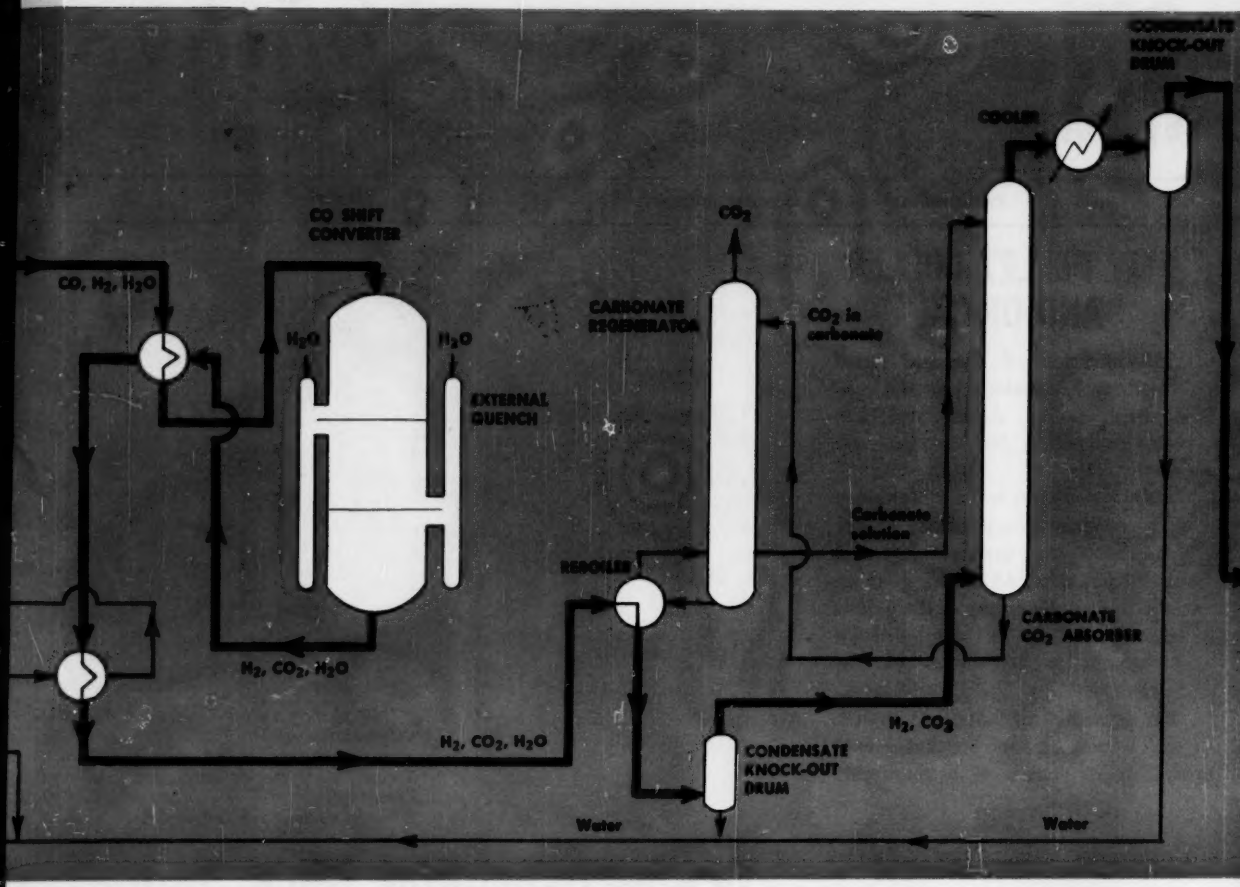
important developments in the past decade in ammonia production has been the advent of partial oxidation of oil (or natural gas) as a source of hydrogen. This discovery has freed the ammonia plant from dependence on areas where coke oven hydrogen, refinery hydrogen or natural gas is available. Ammonia plants can now locate anywhere accessible to oil deliveries.

Originally pioneered by Texaco and Hydrocarbon Research, partial oxidation processes have gained world-wide acceptance in less than five years; there are at least 40 plants throughout the world employing partial oxidation of oil or natural gas for ammonia production (or for methanol synthesis gas). In addition to the Texaco process, Shell (*Chem. Eng.*, Mar. 9, 1959, p. 69) and Montecatini have recently announced partial oxidation processes of their own.

The Befu plant uses the Texaco process. Under Texaco's licensing system, each engineering company or licensee is responsible for designing the gas treatment system for handling gas from the generator; Texaco only furnishes design data for the partial oxidation furnace.

►**Cut Out Carbon**—Chemico engineer K. T. Lee, who designed the Befu plant, explains the problem: "In the partial combustion of oil, 2-4% carbon contained in oil feed will be present in the gas product as small size particles. These carbon particles will foul up the catalyst in the carbon monoxide shift converter unless you get rid of most of them. But some of the particles are so finely divided—under one micron—that not all of them may be removed merely by water scrubbing."

Chemico employed what it claims are two "firsts" in the Befu plant: (1) A "solid" filter that removes carbon which escaped water scrubbing.



This gives a gas containing only 3-5 ppm. carbon going into the CO converter; (2) Novel CO converter design featuring external inter-bed cooling which gives more uniform distribution of quenching water and permits more accurate temperature control (*see cover photo*).

▶**Start With Crude**—Preheated crude oil mixes with oxygen and steam and feeds to the Texaco gas generator where partial combustion at 2,600 F. and 450 psig. produces a gas containing roughly 47% CO and 46% H_2.

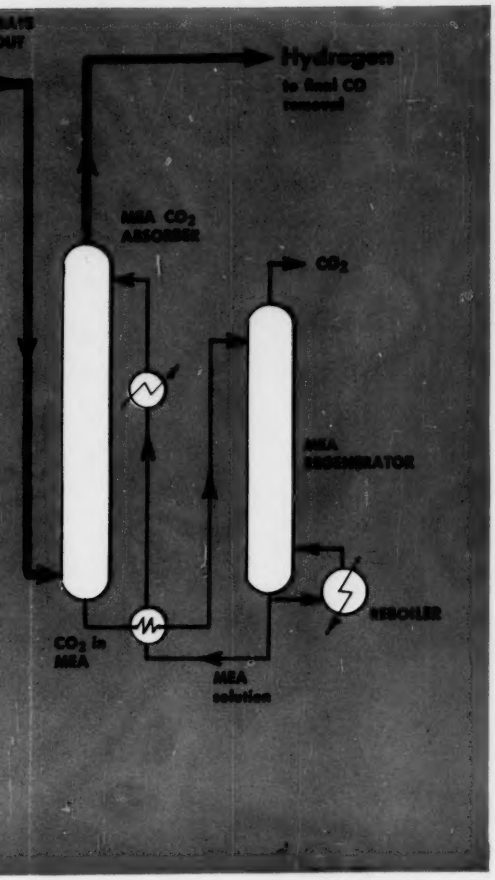
Reactant gas stream is quickly quenched with water in the lower section of the burner. This step generates steam which is utilized in later steps, making the process self-sufficient with respect to steam consumption. Most of the carbon formed by reaction leaves as a slurry in the quench water stream from the bottom of the burner.

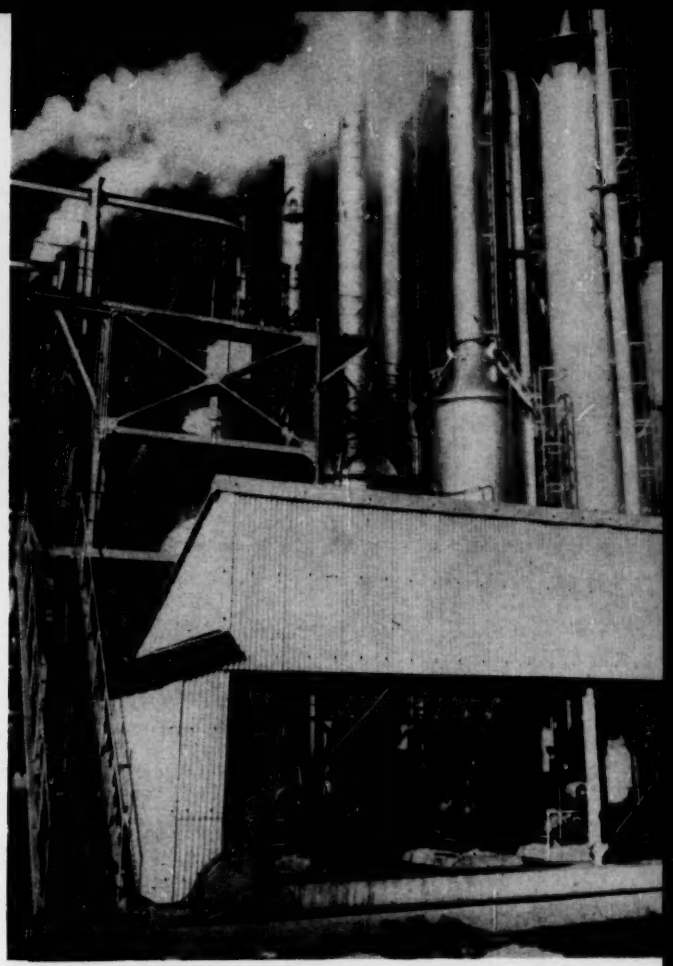
Gas stream then passes to a water scrubber for removal of wettable carbon particles. Packed scrubber contains three beds, with hot scrubbing water recirculated to the second bed for maximum carbon removal. Gas then passes to the "solid" filter to remove the nonwettable carbon. This vessel is filled with "surface active pellets" which Chemico will not identify further. This unit reduces carbon content to 3-5 ppm.

▶**Novel Design**—After the filter, gas passes to the CO converter where catalytic reaction with steam produces more hydrogen according to the classic water-gas reaction:

$$H_2O + CO \rightarrow H_2 + CO_2$$

Gas enters the first bed at 700 F. and is heated by the reaction to about 900 F., then passes to an external quenching pipe where a water spray lowers gas temperature to 700-750 F. After passing through second bed, gas again flows through





PREHEATERS, scrubbers and partial oxidation burner (left) form a backdrop for the plant's pump house.

an external quench pipe and water drops the temperature back to 700 F.

In conventional converter design, this quenching is provided by sparge lines between the catalyst beds. But Chemico says that its design eliminates the chance of water getting into the catalyst as well as providing more uniform steam distribution and affording better temperature control.

▶ **Tandem Attack**—Gas from the CO converter flowing to the CO_2 aborption system first flows through an exchanger to preheat gas going to the converter and then preheats water flowing to the carbon scrubber. Using hot scrubbing water puts more steam per volume of dry gas in the CO-H_2 stream, thereby aiding the CO shift conversion.

To absorb CO_2 from the hydrogen stream, the Befu plant employs a dual absorption system: Hot carbonate scrubbing removes the bulk of the CO_2, then the monoethanolamine system drops final CO_2 content to 20 ppm.

Hot carbonate process comes first in this dual system because it is most economical—removing twice as much CO_2 per Btu. of regeneratng heat as the MEA process. But the hot carbonate system will not get the CO_2 content down to 20 ppm. as will the MEA process, hence the happy marriage of the two.

▶ **Finishing Up**—Gas from the CO_2 absorption system then flows to a caustic scrubber and nitrogen wash unit for removal of any unconverted CO before feeding the ammonia synthesis unit. Final gas analysis runs 75% H_2 and 25% N_2 with impurities in trace amounts.

Carbon in the water slurry from the bottom of the gas generator filters out on a rotary vacuum filter. This carbon sludge is dried by solar heat and marketed as domestic fuel.

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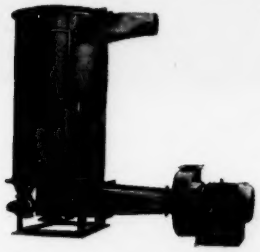
NEW PELLET COOLER AND DRYER

Modification of the patented Rotaircool®, developed for the economical cooling, drying and conveying of pellets, has been recently announced.

Major redesign feature is the use of a compact rotary airlock feeder beneath the tank to receive the cool or dried pellets and discharge them as required. Handling of the pellets from the pelleter to the inlet of the Rotaircool is by means of the Sprout-Waldron Pneu-Vac® negative pressure air handling system which keeps pellet breakage, dust and maintenance at a minimum.

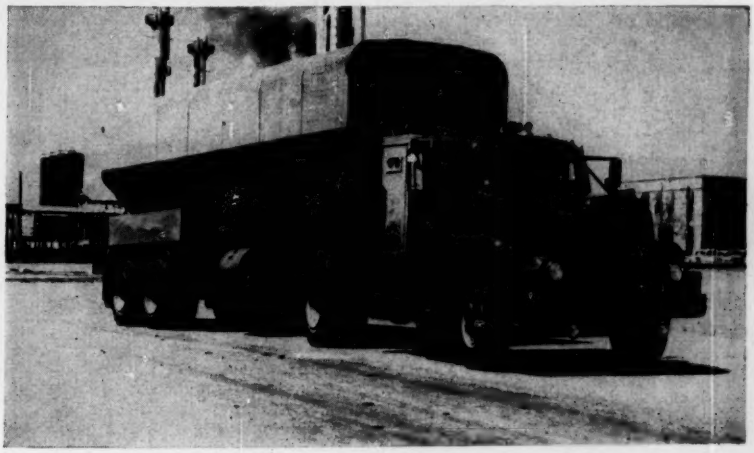


Sprout-Waldron Industrial Rotaircool for cooling, drying and pneumatic conveying of pellets.

By adding heating coils just prior to the pellet inlet, the Rotaircool® system is equally adaptable for heating or cooling. Further details in Bulletin 202.

PRACTICAL PNEUMATIC CONVEYOR DESIGN

A technical article by the Chief Engineer of our Materials Handling Division. It tells how to select, operate and maintain pneumatic systems for transporting dry, bulk materials. Positive, negative and combination systems are illustrated and described. Ask for Bulletin I-28.



One of five Sprout-Waldron Pneumatic Aluminum Bulk Trucks for handling polystyrene pellets in Cosden Petroleum's new "curb service marketing" delivery concept. Note Cosden's modern 32,000 barrel custom refinery in background.

SPROUT-WALDRON BULK TRUCK HANDLES POLYSTYRENE PELLETS

A recent announcement by officials at Cosden Petroleum Corporation, Big Spring, Texas of a new delivery concept, "curb service marketing" is arousing considerable interest throughout the plastic industries. The revolutionary marketing plan involves a delivery of polystrene pellets by special highway transports direct from the purchasing plant to the customer.

The key to the new concept is a group of five 28′ pneumatic aluminum bulk trailer units designed and built by Sprout-Waldron. Each of these trailers has a capacity of 1,182 cubic feet which is equivalent to 34,000 lbs. of polystyrene pellets. The high powered unloading system permits delivery to the customer at the rate of 30 tons per hour. Delivery and storage in bulk cuts down on fringe expenses such as unloading, warehousing, multiple handling and contamination. Bulk storage also permits instant inventory determination. Storage bins can be located at the most suitable point in the plant since the pneumatic unloading system built into the trucks permits delivery anywhere a pipe can be run.

Recent completion of the new polystyrene plant is said to make Cosden Petroleum the first producer able to integrate all phases in the manufacture of this basic material. Both general purpose crystal polystyrene and high impact polystyrene are being produced. The styrene monomer used in manufacturing polystyrene is produced in an adjacent plant also owned and operated by Cosden.

CP/108

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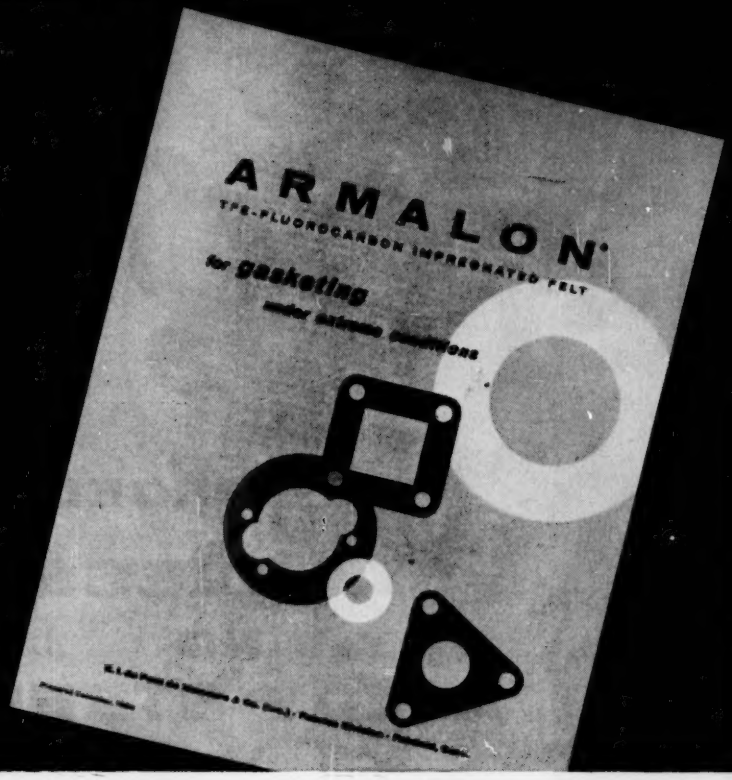

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Fully describes "Armalon" felts—a new class of gasket materials developed by Du Pont for severe service. Includes:

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- Detailed list of specific applications—indicates how and where "Armalon" performs to best advantage
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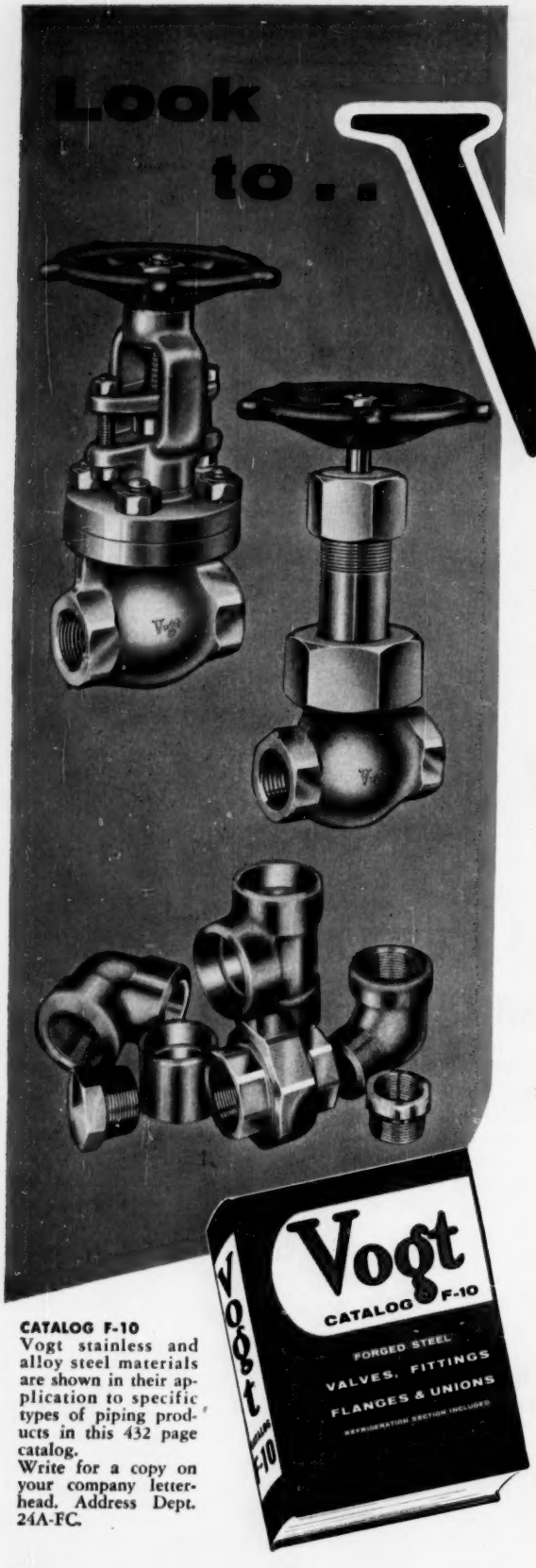

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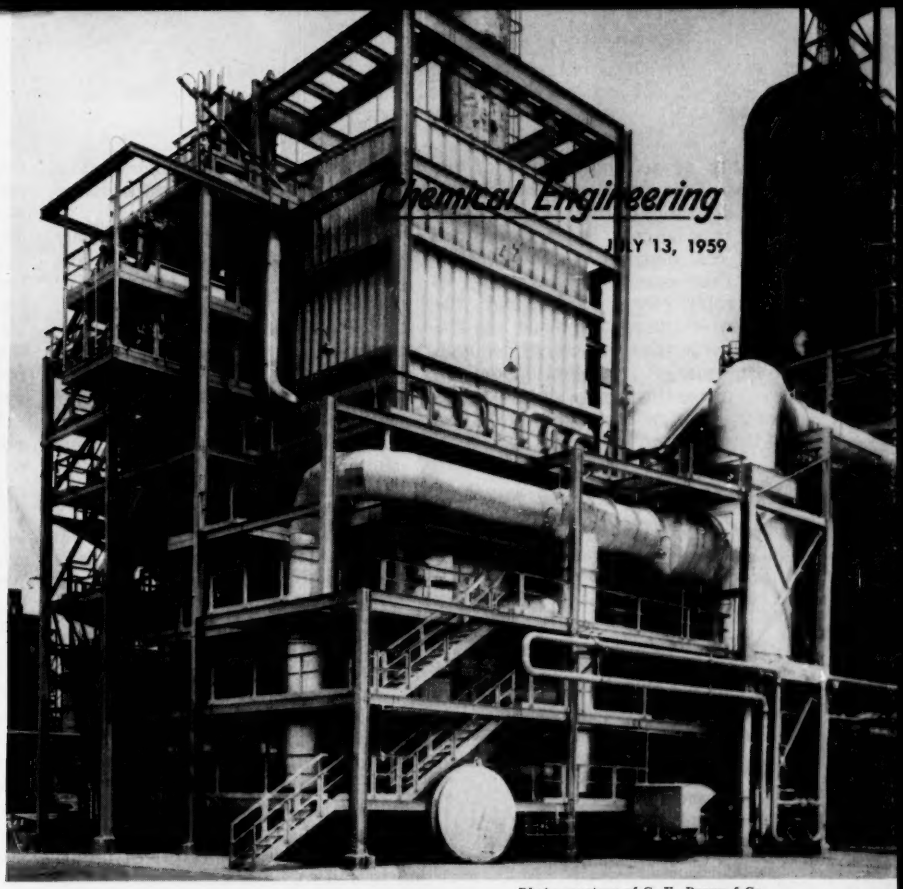


Photo courtesy of C. F. Braun & Co.

Energy for Process Industries

Many factors govern selection of energy source for today's process plants, but final choice rests on developing fuel and energy sources having lowest delivered costs.

HERBERT ARGINTAR, James P. O'Donnell, Consulting Engineers, New York

SELECTION of a process energy source is an individual problem for each plant. It requires a complete analysis of the particular plant's circumstances. Among the many factors influencing the choice are:

- Fundamental needs of the plant.
- Plant location.
- Availability of energy sources.
- Over-all plant operation.
- Methods of energy conversion.
- Cost and type of use of each source.

We'll discuss these factors in general, present useful data, and develop an illustrative example for study. The discussion and reference material which follow provide the chemical engineer with enough data to make preliminary studies.

Before we begin this study, let's briefly review the growth and sources of energy. Since 1900, energy demand of the U. S. has risen

steadily at an annual rate of increase of about 3%. In the 30-year period prior to 1947, demand for coal was almost constant. Since 1947, coal demand has been declining. Petroleum and natural gas, in particular, have furnished both the energy of the replaced coal and the increase in the total energy demand. With energy consumption on an ever-increasing scale, it is important to review the energy problems of the chemical industries.

Examine Fundamental Needs

Most plants require one of three basic types of energy or source power as shown in Table I. The general forms of these types are: heat, electrolytic and motive.

Use Determines Needs—Table I

Predominant Energy Requirement
Heat
Coal carbonization
Distillation processes
Ore roasting and reduction
Petroleum refining
Portland cement
Electrolytic
Aluminum
Chlorine—caustic soda
Copper
Magnesium
Sodium
Sorbitol
Motive Power
Conveyors
Crushers
Ore mining
Pumps
Sifters
Rolling mills

Natural Sources of Energy—Table II

Solar
Coal
Coke
Electricity
Manufactured gases
Steam
Petroleum
Coke
Electricity
Manufactured gases
Refined fuels
Steam
Natural Gas
Electricity
Steam
Falling Water
Electricity
Uranium
Atomic power

Heat is probably the most widely needed requirement for process plants. Heat energy is essential for plants performing operations such as distillation, fractionating, heat-controlled mixing and endothermic reaction. Any plant having one or more of these processes as a major process element will be concerned with heat energy sources and their conversion to production of useful work. Such plants include those producing oils, alcohols, metals, some pharmaceuticals and portland cement. The preceding illustrations assume, of course, heat directly applied to the process.

In many instances, heat energy sources are applied indirectly by means of conversion to another form of energy. A specific example would be the production of electricity, in lieu of purchased power. To refer to electricity as a natural energy source available directly for industrial use, might be considered to overstep the bounds of natural energy source. However, in industrialized regions, electricity is available in such quantity, quality and low cost, that it becomes a prime source.

Thus, it is more advantageous for some plants to use electrical energy directly instead of a heat energy source which is converted, by and at the plant, to electricity. Plants primarily requiring chemical dissociation or refining for elemental metals such as copper, sodium, aluminum or other electrolytic process would probably find electricity to be a needed energy source.

Motive power is not energy, as such. However, it is the essential requirement to be satisfied in a materials handling plant. Mining, ore beneficiation, and product packaging plants are in this class. In such a plant, the engineer will be very much concerned with the application of a suitable heat or electric energy source. Thus, though the motive power is the prime concern, the problem ultimately resolves itself to the basic source of heat.

Define Energy Sources

Consideration of these requirements indicates that regardless of the need, the problem of basic energy type reverts to the original natural source. Natural sources would normally be the sole type to consider in an underdeveloped area. However, as was illustrated for electricity, there are other sources, not natural, but primary. These are the sources furnished, usually, by the utility industry. For most industrial areas, these primary sources are electricity, steam, which is converted from heat energy, manufactured gas and natural gas.

Utility-furnished primary sources become secondary sources at some of the larger plants. These secondary sources are produced at the plant, sometimes using a byproduct as a prime or natural heat source. This, though, is beyond the scope of what comes into the plant limit.

Imposing boundaries on energy source classification is not inclusive of every individual case. Thus, it becomes apparent that at the very outset, the selection of primary process energy is an individual selection. However, the major sources within the reference framework are shown in Table II. Omitted from the tabulation are such local items as bagasse. Regardless of its low thermodynamic efficiency, it could be a prime energy source for a sugar refinery located in a remote area, which only produces and refines cane sugar. But its application is very limited.

Atomic power is being applied to the production of electric energy at the present time and undoubtedly comes to mind. In 1958, there had been initiated 21 stationary civilian nuclear power reactor projects with electric capacities of 5,000 kw. or larger. Four were operational, nine under construction or contract, and eight in the planning stages. The total ultimate generating capacity will be approximately 1,700 megawatts or about 1% of the total U. S. electrical capacity. Thus, while atomic power is included in Table II, its use at the present time is limited.

Methods of Energy Conversion

Recent experiments wherein atomic energy is converted to electricity represent a change of one energy form to another. For work to be performed, the energy must be used. Each time the energy or mass is converted from one form to another before its final use, there is a loss and, therefore, lesser over-all conversion efficiency. Thus, a four-step conversion is less efficient than

a single or two-step conversion. Nevertheless, it is sometimes necessary to use the less efficient method. Some typical examples of these conversions are shown in Table III.

Our presentation, up to this point, establishes the elements of the problem. However, the selection and use of process energy for a particular plant is determined by comprehensive analysis of each part of the problem and its relation to the whole. The following discussions attempt to develop these ideas.

Location Affects Energy Source

Selection of a plant site is determined by consideration of many factors such as:

- Available area for lease or purchase.
- Location and type of transportation facilities.
- Available labor, its quality and cost.
- Business and other taxes.
- Available utilities and other energy sources and their costs.

The above tabulation is not all-inclusive, but it is enough to indicate that the process energy source is not always, and most seldom, the sole consideration. However, once the site is selected, the plant engineer will probably be concerned with efficient use of available sources at, or transported to, the site. Then, he must consider desired process production reliability and energy conversion economics.

There, probably, are several instances where the availability of energy sources or raw material do have great influence in plant site location. Generally, this situation occurs where investment and marketing factors do not take priority in site selection.

Process Production Reliability

Selection of the energy source is often related to production reliability. If heat from release of a natural energy source is essential to a process which would be costly to interrupt, availability of the energy source, or alternatives for any emergency, is of prime importance.

When considering an economic life of considerable length, the forecast of probable cost-life of a source would be important. This is particularly true when the plant is located in an area from which the source is derived and the number of available alternates is limited.

Energy use also is important when considering the selection of the energy source for the process. For example, an electrolytic bath requires electric energy. As long as this energy is supplied, the process can continue. It is very unlikely that a local operator gives a second thought to the source of power. To him, electricity is electricity, and his only concern is that it be supplied to the process. But, to the process engineer, the source of electricity is important to continuity of the process.

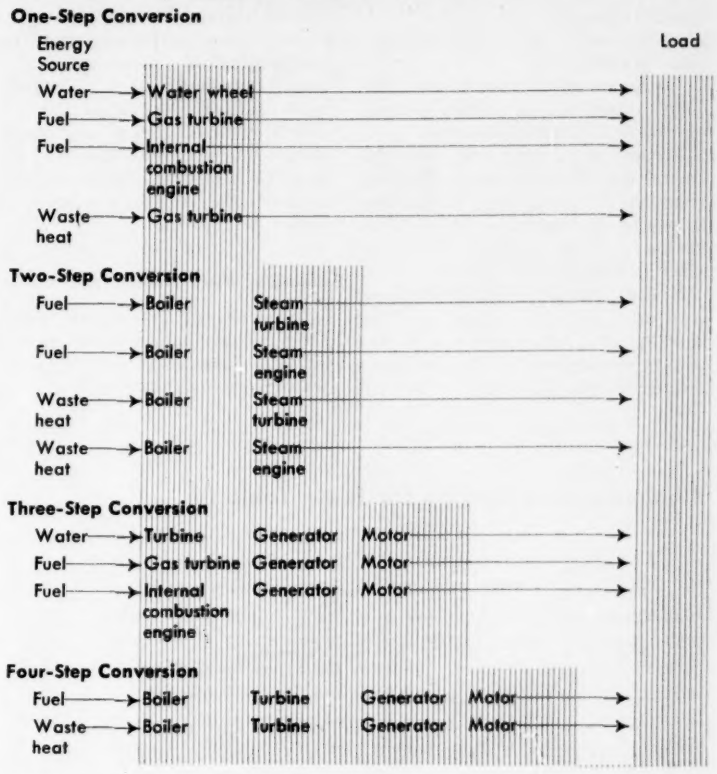
A three- or four-step conversion method will permit the plant to generate its own power with a reasonably wide selection of original energy sources. However, the breakdown, turn-over maintenance, or other cause of interruption in the power plant will cause a loss of the usefully employed electrical energy. Contrariwise, purchase of power probably will be much more reliable. Whatever causes an interruption of service at the plant's power station, might similarly cause a utility interruption. But, for a utility, the interruption generally would be local, and the utility's system would still provide energy for its customers. This example may appear to be an oversimplification; but it illustrates the relation between energy source and process reliability.

Economics Influence Source

Economics greatly influence the selection of the energy source. But it is not simply the economics of cost of source. Consideration also includes:

- Economic life of source.

Methods of Energy Conversion—Table III



In either three- or four-step conversion, another step may be added by rectification of a.c. to d.c. power.

• Economy of additional investment to provide for alternate or standby sources.

• Economy of applied conversion method.

• Economy of using less efficient byproduct or waste sources vs. efficient purchased source.

Initial and operating cost of energy conversion equipment is beyond the scope of this discussion. However, samples of useful data for various energy sources are hereafter presented for reference.

Energy supply, availability and cost, and energy sources and resources are data essential to the proper evaluation of the problems discussed thus far. In the succeeding pages, these data are presented and discussed, as applied to the United States. An amplified discussion of the evaluation of the future availability of resources is intentionally omitted. Its value would be most useful to very large plants for which comprehensive engineering studies would be required. The data may be obtained from standard sources referred to at the end of this report.

Mineral Fuel Industries

Total energy production, and individual production from mineral-energy fuels and energy from waterpower is shown in Fig. 1. The energy is represented in terms of heat content for each source. The status of the national economy, political, production cost, and other factors generally affect the mineral fuels industry. This is evident when the periods 1917-1919, 1929-1932, and 1939-1944 are examined for the relative production.

It is interesting to note the production change in coal as contrasted with natural gas during 1929-1932. Production cost, as well as introduction of better methods of using the cleaner gas very likely affected production output. Observation of the end of the graphs in 1957 shows changes resulting from contraction of the economy and closing of the Suez Canal that year. However, the general trend indicates an expansion of the production of energy with the implied reminder that we are depleting our natural resources more rapidly with time.

Fuel costs are closely related to production and consumption. Tables IV and V provide such data. Table IV should be particularly useful as it can be related to other cost indices; and future prices approximated based on predicted trends of such indices.

Wholesale Price Indexes for Fuels—Table IV

	All Fuels	Coal	Coke	Gas	Electricity	Petroleum and Products
1948-52 (avg.)	105.1	107.1	116.1	101.3	99.8	107.1
1953	109.5	112.8	132.0	107.8	99.1	112.7
1954	108.1	106.3	132.5	108.8	101.8	110.8
1955	107.9	104.8	135.2	111.6	97.4	112.7
1956	111.2	114.5	149.7	115.1	94.2	118.2
1957	117.2	124.4	161.7	116.1	95.5	127.0

Base period 1947-49=100

Comparative Fuel Prices—Table V

	1956	1957
Bituminous Coal		
Screenings for industrial use, fob car at mine, to industrial consumers	$5.08/ton	$5.56/ton
Metallurgical coal, fob. car at mine, to coke manufacturers	6.19/ton	6.64/ton
Average retail price	15.65/ton	16.28/ton
Cost of coal at merchant coke ovens	9.85/ton	10.76/ton
Anthracite Coal		
Chestnut	12.07/ton	13.06/ton
Pea	8.95/ton	10.39/ton
Buckwheat No. 1	7.16/ton	9.21/ton
Petroleum and petroleum products		
Crude petroleum at well	2.79/bbl.	3.09/bbl.
Fuel oil, No. 6 at Philadelphia	2.96/bbl.	3.31/bbl.
Bunker C, average for all Gulf ports	2.19/bbl.	2.85/bbl.
Distillate fuel oil No. 2, average at Philadelphia	10.4¢/gal.	11.1¢/gal.
Distillate fuel oil No. 2, average for all Gulf ports	9.2¢/gal.	10.0¢/gal.
Natural Gas		
U. S. average value at well	10.8¢/1,000 cu. ft.	11.3¢/1,000 cu. ft.
Average value at points of consumption	41.5¢/1,000 cu. ft.	43.1¢/1,000 cu. ft.

Liquefied Petroleum Gas

From the data shown in Fig. 2. we find that the volume of liquefied petroleum gases is constantly increasing. Data for these curves are given in Table VI. This table indicates that the Southwest, particularly Texas, is the geographical area of the major sources of these products. Costs are included and provide information for obtaining representative product costs when estimates must be made.

Liquefied petroleum gas is also refinery produced. Delivery increases to chemical plants for use as raw material and solvents were higher in 1956 and 1957 than deliveries for domestic and commercial uses elsewhere. Sales for synthetic rubber components, internal-combustion engine fuel, and industrial plants fuels also were high. Therefore, Table VII showing the location of these sources is included for reference.

Prices of the various fuels are not as variable as the stocks of fuel. The average price in 1957 of propane fob Houston, was 4.38¢/gal. compared with 4.78¢/gal. in 1956. The average price in January of

5.13¢/gal. declined to a low of 3.88¢ in July and then increased to an average of 4.77¢ in December.

Producers received an average of 3.96¢/gal. for LP-gases in 1957, compared with 5.09¢ in 1956. Reserves had little influence on these variations in price.

Natural Gas Resources

Production and prices of natural gas for 1940-1957 are shown in Fig. 3. Data for these curves also indicate the major sources are obtained from the Southwest, particularly Texas.

Consumption of natural gas is shown in Fig. 4. Use has constantly increased. Between 1956 and 1957 increased use by consumers were: industrial fuel, 5.8%; total industrial, 5.1%; portland cement industry 1.4%; residential, 7.4% and commercial 8.2%.

Average wellhead price in 1957 was 11.3¢/1,000 cu. ft.; while average point-of-consumption price was 43.1¢/1,000 cu. ft. Data for representative states is shown in Table IX.

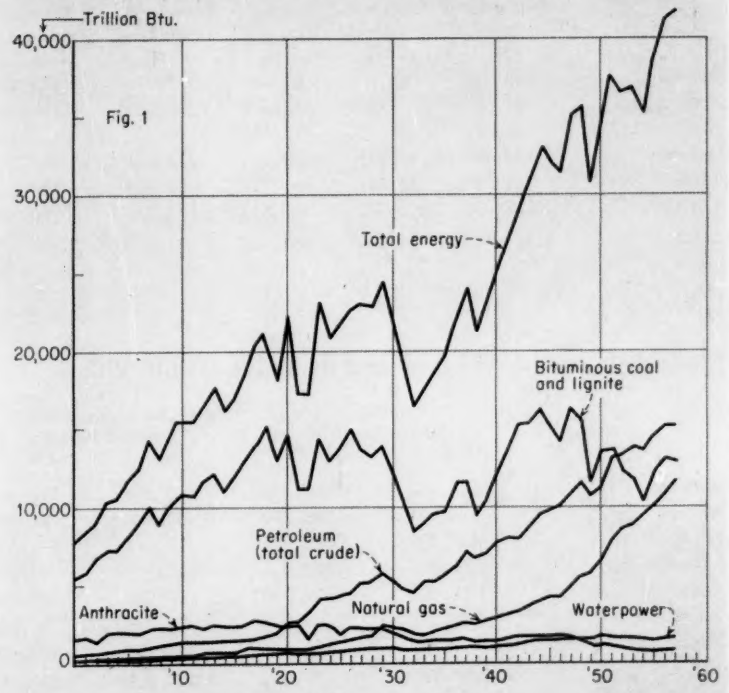
Anthracite Coal

Losses to competitive fuels, particularly natural gas were the principal causes of the decline in production and price of Pennsylvania anthracite. The greater part of the decline probably occurred in the use for heating and other domestic purposes. Industrially, some uses

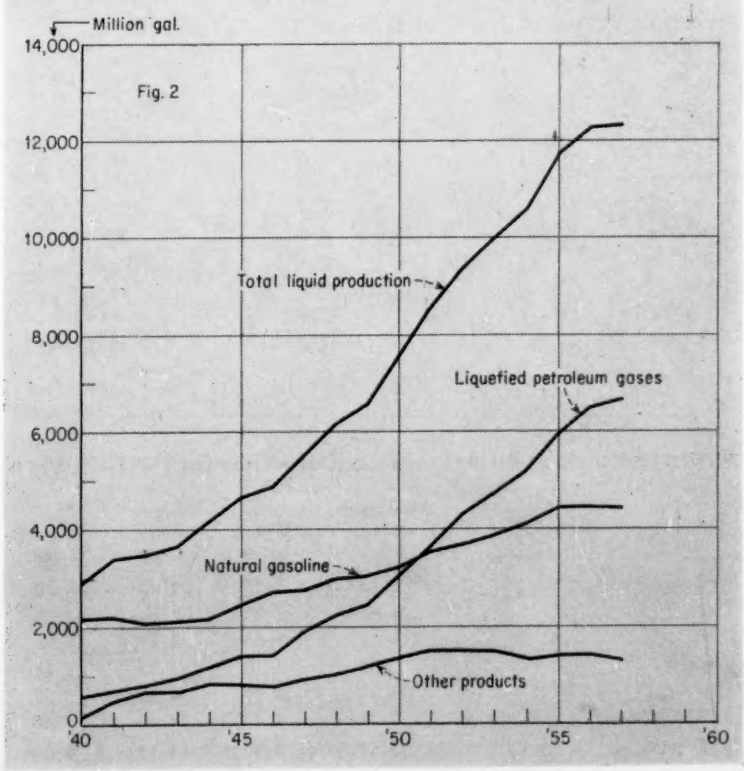
Value of LPG for 1957—Table VI

	Thousand Gallons	Thousand Dollars
Arkansas	54,034	2,097
California	390,743	20,421
Colorado	73,911	3,785
Illinois	364,635	15,549
Kansas	103,494	4,042
Kentucky	176,033	7,403
Louisiana	335,142	14,888
Mississippi	10,044	472
Nebraska	57,615	3,305
New Mexico	375,930	13,046
Oklahoma	587,140	21,824
Pennsylvania	1,211	106
Texas	3,831,664	147,618
West Virginia	235,881	6,543
Wyoming	57,805	2,566
Total	6,655,282	263,665

Mineral Fuels Provide Almost All of the Energy in U. S.



Natural Gas Is Prime Source of Liquefied Petroleum Gas



Refinery Production of LPG for 1957—Table VII

	Propane, Thousand Gal.	Butane-Propane, Thousand Gal.	Butane, Thousand Gal.	Other LPG, Thousand Gal.	Total, Thousand Gal.
East Coast	238,056	.....	40,026	.....	278,082
Illinois	101,682	420	15,540	.....	116,802
Ohio	83,496	.....	18,690	.....	102,186
Louisiana	124,278	21,126	60,522	236,586	442,512
Texas	329,280	14,826	351,120	89,586	784,812
California	188,412	6,972	60,018	15,330	270,732
Total	1,204,098	65,268	582,960	392,028	2,244,354

Production of Natural Gas and Its Value—Table VIII

	Quantity, Million Cu. Ft.		Estimated Value at Wells, Thousand Dollars	
	1956	1957	1956	1957
California	504,458	492,338	113,503	116,684
Kansas	526,091	586,690	59,448	66,883
Louisiana	1,886,302	2,078,901	215,038	232,837
New Mexico	626,340	723,004	55,118	67,962
Oklahoma	678,603	719,794	54,288	59,743
Pennsylvania	104,508	101,801	33,652	31,660
Texas	4,999,889	5,156,215	434,990	500,153
U. S.	10,081,923	10,680,258	1,083,812	1,201,759

Average Value of Natural Gas for 1957—Table IX

	At Wells, ¢/1,000 Cu. Ft.	At Point of Consumption, ¢/1,000 Cu. Ft.
California	23.7	45.0
Kansas	11.4	27.1
Louisiana	11.2	17.9
New York	28.4	128.9
Oklahoma	8.3	22.9
Pennsylvania	31.1	72.7
Texas	9.7	16.4
West Virginia	23.8	43.4
Average U. S.	11.3	43.1

Average Value of Bituminous Coal at Mines for 1957—Table X

	Underground Mines, $/ton	Strip Mines, $/ton	Auger Mines, $/ton	All Mines, $/ton
Alabama	6.74	5.25	3.40	6.49
Kentucky	4.91	3.38	3.86	4.53
Ohio	4.65	3.64	3.71	3.96
Pennsylvania	6.34	4.10	3.55	5.77
Virginia	5.33	3.96	4.11	5.22
West Virginia	5.71	4.43	4.48	5.58
U. S. Total	5.52	3.89	4.12	5.08

increased, others declined. Electric power utilities, the largest industrial consumers, increased their consumption slightly. A slight gain was also made as an admixture with bituminous coal in the manufacture of oven coke.

However, these facts should not discourage the process plant engineer from investigating the use of this fuel. Though there are operational and maintenance advantages to the petroleum products, a modern coal handling plant may also be desirable for heat production.

Bituminous Coal

Availability of bituminous coal from mines predominantly throughout the eastern half of the United States, should increase its appeal over the hard coals. Though its production has also shown continuous decreases, as petroleum products increased, this particular form of coal holds its own in coke plants, cement mills, and other industries.

Electric power utilities are still large consumers and have continuously improved its energy-release efficiency. In 1957, 0.93 lb. of coal was required to produce 1 kwh. Continued improvement in combustion efficiencies resulted from advanced boiler design and the use of higher steam pressures up to and including the supercritical.

For small process-plant type application the Bituminous Coal Research, Inc., has designed and built a fully automatic, coal-fired, package boiler plant, utilizing a water-cooled, pulsating grate. These units can be obtained for requirements of 1,500 to 20,000 lb./hr. of steam and pressures up to 300 psi.

However, the significance of Table X, which shows the varied sources and average value must not be confused. Average value is not the consumer's price. The data exclude transportation, handling and distribution costs. Average retail price is about 325% of the average value. As a further reference, Fig. 5 shows how this average value has varied throughout the years. How coal can be used more economically in some older existing plants that have not been modernized is shown in Fig. 6.

Purchased Electric Energy

Total generating capacity in the United States in 1957 was roughly

146 million kw. It is estimated that this figure will almost double in the next decade. The figure, itself, represents more than double the capacity a decade ago. An energy source such as this must certainly be investigated.

Growth of electric generation is shown in Fig. 7.

In addition, the growth, as well as present quantity of capacity according t ownership is shown. It is interesting to note that less than 10% of the total is self-generated by all industry.

Distribution of the source of this energy throughout the country is shown, by regions, in Table XII. It is obvious the greater production is near the greater industrial, and larger populated areas.

As previously discussed, electric energy is actually a secondary source. The primary energy into the prime mover is of interest. However, electricity generated from fuel has increased at a greater rate than electricity from hydropower. In 1920, the fuel-hydro ratio was approximately 1.57. Today, it is 3.86. Of all thermal generation today, coal is the most important source, and furnishes approximately 71% of the total. Gas is second with approximately 22%, and fuel oil is third with about 7%. However, most of the conversion is four-step conversion because steam accounts for about 80% of the total production, internal combustion engines about ½% and hydro provides the balance.

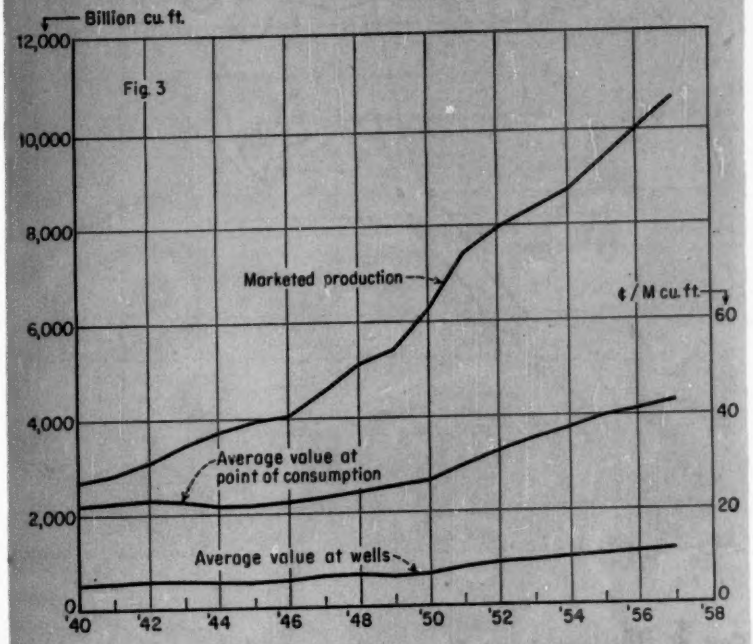
Whether or not a process plant should generate its own power is dependent, in part, upon fuel prices. However, efficient use of the fuel will reduce the over-all cost. Regional data showing actual costs and heating values, for the year 1956, are shown in Table XIII. These data should be very helpful in making economic studies. Additional data for purchased power estimates are given in Table XI. As will be seen, the cost of electricity has constantly decreased through the years.

Other Factors to Consider

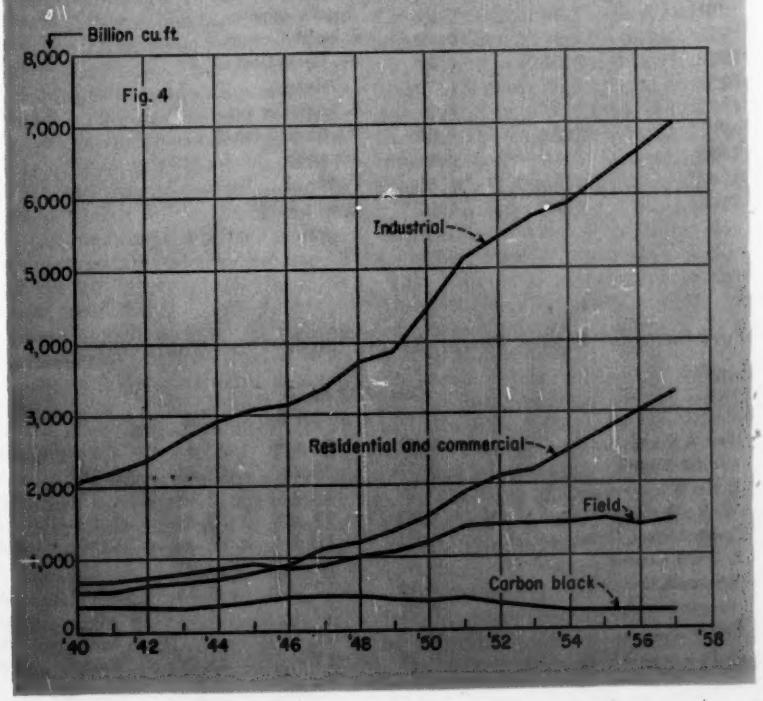
Plant location was discussed previously. Data in this regard should be mentioned, as these sources and types of information are not generally appreciated.

Information can usually be obtained from the various State

Production and Average Value of Natural Gas in U.S.



Industry Is Largest Consumer of Natural Gas



Average Value at Mines of Bituminous Coal

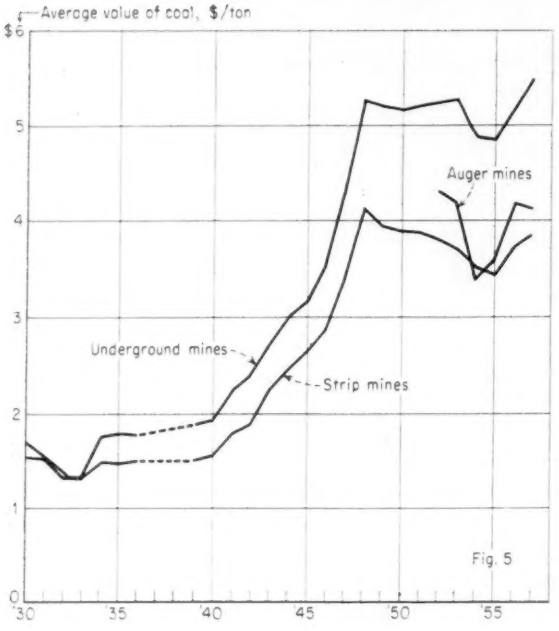


Fig. 5

Fuel Economy at Electric Power Plants

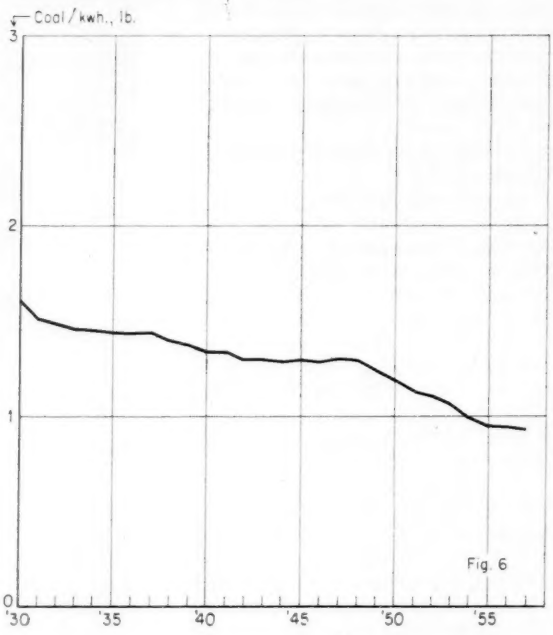


Fig. 6

Cost of Electricity—Table XI

	Commercial and Industrial Users	
	Small Firms, ¢/Kwh.	Large Firms, ¢/Kwh.
1957	2.42	0.92
1956	2.45	0.89
1955	2.47	0.99
1954	2.52	0.99
1953	2.53	1.00
1952	2.55	1.01
1951	2.55	1.00
1950	2.64	1.01
1949	2.66	1.05
1948	2.67	1.01

Steam Prime Movers Dominate Generator Drives—Table XII

	Installed Generating Capacity for 1957		
	Steam, Thousand Kw.	Hydro, Thousand Kw.	Internal Combustion Thousand Kw.
New England	4,506	1,258	111
Middle Atlantic	17,648	1,522	76
E. North Central	27,858	850	384
W. North Central	6,605	1,299	1,023
S. Atlantic	13,594	3,548	188
E. South Central	9,477	3,693	29
W. South Central	9,645	945	433
Mountain	2,863	3,784	222
Pacific	7,070	10,052	54
U. S. Total	99,266	26,951	2,520

Fuel Costs for Electric Power Generation in 1956—Table XIII

	Cost of All Fuels		Coal		Oil		Gas	
	¢/Kwh.	¢/Million Btu.	$/Ton	Btu./Lb.	$/Bbl.	Btu./Gal.	¢/1,000 Cu. Ft.	Btu./Cu. Ft.
New England	0.50	39.6	10.55	13,606	2.63	149,661	38.4	1,011
Middle Atlantic	0.37	30.8	7.63	12,743	2.53	149,448	33.7	1,059
E. North Central	0.27	24.4	5.68	11,579	4.75	140,948	13.5	610
W. North Central	0.32	24.6	5.65	10,504	3.30	144,940	22.3	1,008
South Atlantic	0.32	28.8	7.04	12,750	2.48	149,636	24.8	1,025
E. South Central	0.19	19.1	4.53	11,897	2.77	155,542	20.7	1,047
W. South Central	0.15	12.0	4.36	14,273	2.66	148,856	12.7	1,059
Mountain	0.29	22.4	4.02	9,371	1.82	152,548	22.1	990
Pacific	0.35	29.6	....	.....	2.17	151,797	28.2	1,080
U. S.	0.29	25.4	6.29	12,030	2.42	150,329	18.9	1,001

Chambers of Commerce, Department of State, or railroads. The data obtainable from these sources generally include:

- Plant site data.
- Population and available labor force.
- Available utilities and their costs.
- Transportation facilities.
- Taxes.

Because the St. Lawrence Seaway, which has just opened, might be of interest, a typical site description is presented here. The data are taken from "The Greater St. Lawrence Seaway Area, New York State, Industrial Sites," as published by the New York Central System.

How to Evaluate Fuel Source

Application of the ideas and data presented here will round out the entire study. Accordingly, a basic study to discuss fuel source will be developed. This study is typical of the primary energy application to a plant process. In this problem, we will attempt to show the thinking required, in part, by the process engineer for evaluating alternate sources of fuel.

Consider the process engineer's problem when given a flowsheet and a heat and material balance as shown in Fig. 8 and Table XIV. If the problem were directed to heat alone, a study could be made of all the forms of energy sources available at the plant site considering only equivalent heating value and conversion method.

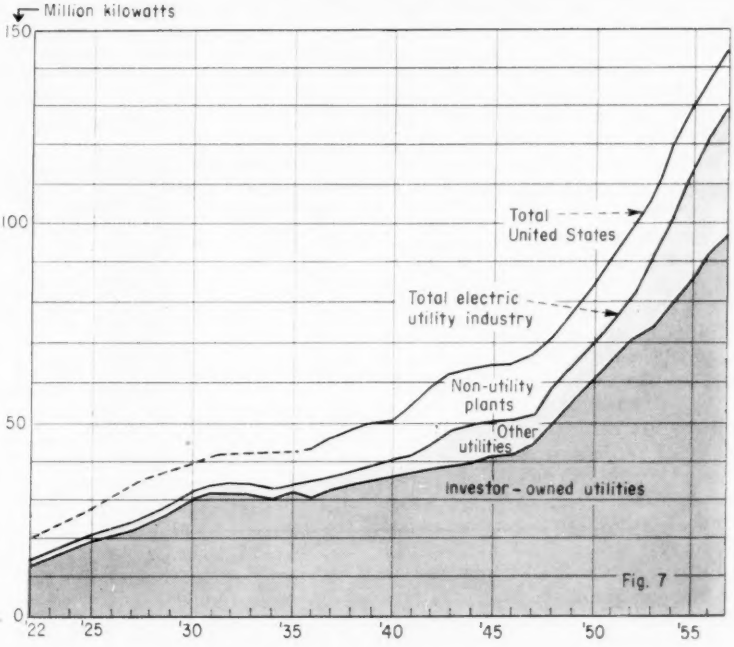
To put direction and uniqueness into this example, let us assume:

1. Plant is located near the St. Lawrence Seaway.
2. Continuity of operation is essential.
3. A preliminary study regarding fuel selection is necessary.

The NYCRR data indicate that natural gas is available from the utility. This will be natural gas at an estimated heating value of 1,000 Btu./cu. ft. at a cost of approximately 70¢/1,000 cu. ft.

Other nonutility fuels are also available, and may be attractive because of the good transportation facilities at the site. However, if they are fuel oil or coal types, it is apparent a considerable storage area and facility would be required to store adequate quantities of fuel between deliveries. In an amplified study, these fuels should be investigated.

Generating Capacity Shows Threefold Growth Since 1940



Provide Continuity of Process

However, there is another element to this problem that may have a greater influence on selection than local availability. This is the fact that outages in production are to be avoided. The fuel supply, or lack of it, can obviously contribute to the outage. A curtailment or cutoff of the natural gas supply due to local distribution or transmission line failure is a possibility. A service interruption where the gas is sold on an interruptable basis is also a probability.

These considerations, as well as the presently uninvestigated possibility of high maximum demand charges for peak loads in the future, suggest that an alternate or standby fuel be provided. This alternate would require storage facilities. Since, the alternate provides standby service, the demand would be much smaller than it is for the prime fuel. Consequently, the storage facility required is much smaller than that required for the prime fuel.

The storage requirement reintroduces the value of fuel oil or coal. However, these necessitate a distribution method from storage to burner different from that required for gas. The combustion system would also be different. However, LP gas overcomes these disadvantages. When properly mixed with air, LP gas can be used interchangeably with manufactured or natural gas. It can therefore be used through the same distribution system and combustion devices. Further, LP gas is relatively cheap.

Now, LP gas from a direct source is rarely used as a standby for manufactured or natural gas because its cost is often much lower. Thus, the preference would be to use it exclusively. However, if it is unavailable from a direct source, its use is attractive for situations such as outlined here. In fact, many utilities follow this practice. This doesn't entirely answer the process engineer's problem.

The process engineer must study the economy of LPG as standby. In general, he must recognize these factors:

1. Distance from source. Often freight is more than cost of LPG at shipping point.
2. Industrial gas curtailment

Use Heat and Material Balance Flowsheet To Determine Process Heat Requirements

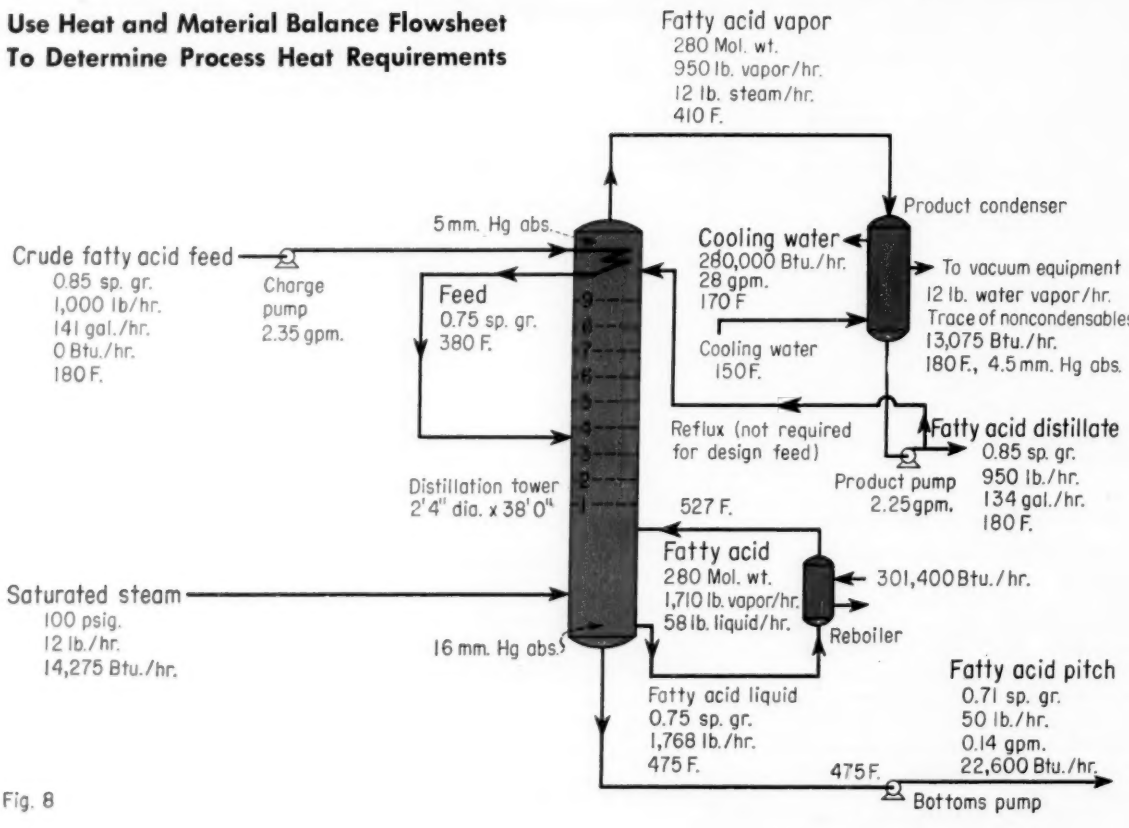


Fig. 8

Heat and Material Balance for Problem—Table XIV

Heat Entering the System		
In feed	0 Btu./hr.	
In steam	14,275 Btu./hr.	
At reboiler	301,400 Btu./hr.	
Total heat entering system		315,675 Btu./hr.
Heat Leaving the System		
In distillate	0 Btu./hr.	
In pitch	22,600 Btu./hr.	
From condenser	13,075 Btu./hr.	
In cooling water	280,000 Btu./hr.	
Total heat leaving system		315,675 Btu./hr.
Process Materials		
Feed in		1,000 lb./hr.
Fatty acid distillate out	950 lb./hr.	
Fatty acid pitch out	50 lb./hr.	
Total process materials out		1,000 lb./hr.

period can result from low temperatures or line failure. Daily gas requirement and the possible curtailment period will determine the LPG reserve requirement.

3. Local utility demand charges.

4. Cost of outage time compared with costs for LPG storage and use facilities. Storage and handling is expensive. The equipment includes 250-psi. working pressure storage tanks; tank foundations; unloading, vaporizing and diluting equipment. Cost varies with required distribution pressure; buildings; real estate, and carrying charges. Maintenance and operation all are relatively expensive items which build up standby cost.

When these items are considered, the process engineer will be able to evaluate more properly the over-all problem. However, the high storage pressures and heat content of the fuel make study worthwhile.

Storage tanks for LPG are usually constructed of 18,000 or 30,000 gal. gross capacity (15,000 or 25,000 gal. net). The smaller tank holds the equivalent of 2.5 million cu. ft. of manufactured gas, or approximately 1.5 million cu. ft. of natural gas. The larger tank holds the equivalent of 4.3 million cu. ft. of manufactured gas or about 2.5 million cu. ft. of natural gas. Add to these data, the prices for LPG, and a study can be made.

Pennsylvania LPG/has an average value of approximately 9¢/gal. as shown in Table VI. Table indicates an average fob Houston, price of 4½¢/gal. For Pennsylvania LPG to be competitive, the local price of the Texas product must be almost double the fob price, which indicates the cost of transmission and distribution. Data are not given for the actual cost of LPG in the particular area, so assume the price is 11¢/gal., for intermittent delivery, as in this problem. Plant location was actually selected to emphasize the use of plant location data, as well as illustrate the consideration to be given this type of problem.

In order to evaluate the problem economically, let us assume the following additional data, as well as restate the data previously presented.

1. Natural gas supplied at 30 psig. and used on high pressure inspirating-type burners.
2. Total of four days gas curtailment, six times a year.
3. Cost of LPG delivered is 11¢/gal.
4. Cost of natural gas is 70¢/1,000 cu. ft.
5. Over-all thermal efficiency is 50%.

We begin our calculations for this study by finding the daily gas consumption necessary to supply 320,000 Btu./hr. For 24-hr. operation, heat requirement is 320,000 $\times$ 24 = 7.7 $\times$ 10^6 Btu./day. Using natural gas having a heat value of 1,000 Btu./cu. ft. and burned at 50% thermal efficiency requires 2 $\times$ 7.7 $\times$ 10^6 $\times$ 1/10^3 or 15.4 $\times$ 10^3 cu. ft./day of natural gas to supply the necessary heat.

Next, we estimate the LPG standby consumption. Approximately 11 gal. of liquid propane equals 1,000 cu. ft. of natural gas. Hence, LPG equals 15.4 $\times$ 10^6 $\times$ 11/10^3 = 169,400 gal./day. Allowing for thermal efficiency, standby requirement of LPG is 2 $\times$ 169,400 or 338,800 gal./day.

Storage costs for tanks in this area are approximately 50¢/gal. If we use tanks having a gross capacity of 30,000 gal. (net of 25,000 gal.), we need 338,800/25,000 = 13.5 tanks. Actually, 14 tanks are necessary. Therefore, total storage will be 14 $\times$ 25,000 or 350,000 gal. Cost of these tanks is $175,000.

Unloading equipment, vaporizer, diluting valve, compressor and work tank will cost about 20% of storage cost. Hence, the other equipment will add $175,000 $\times$ 0.20 or $30,000. Total standby equipment cost is $205,000.

Propane at 11¢/gal. is equivalent to $1.21/1,000 cu. ft. of natural gas. Incremental cost of using standby LPG is ($1.21 — 0.70) or $0.41/1,000 cu. ft. of gas. Total cost of using standby LPG during natural gas curtailment is 15.4 $\times$ 10^6 $\times$ $0.41/$10^3$ = $6,300/day.

Weather conditions at this location may cause six 4-day shutdowns per year. Cost of outage because of loss of profit, wages, etc. is $8,100/day. Hence, six outages of four days each cost 24 $\times$ $8,100 or $194,400. Thus, the LPG installation is worth approximately $195,000 per year.

Incremental cost of LPG fuel for a total of 24 days outage is $151,000 over natural gas. By using the standby LPG, there is available $44,000 for amortization of standby facilities. Since these facilities cost $205,000, amortization will occur in approximately five years.

With the above study, the process engineer has a good lead for a detailed study. The preliminary study, based upon the stated assumptions, indicates the feasibility of using utility-furnished natural gas and providing an LPG standby storage system. This conclusion is the interpretation of approximate amortization time. However, initial cost of standby facilities must also be weighed. The flow sheet indicates a medium-size plant. Initial storage cost may be disproportionately large for the investment capital available.

Some of the advantages to be

Compare Generated to Purchased Power for the Chemical Process Industry—Table XV

	Purchased Cost, Thousand Dollars	Purchased, Million Kwh.	Generated, Million Kwh.	Total Million Kwh.	Generated, Percent of Total
Chemicals	223,639	40,783	13,754	54,537	25.2
Coke and byproducts	8,482	849	304	1,153	26.3
Drugs and medicines	10,931	945	103	1,048	9.8
Explosives and fireworks	20,772	1,761	83	1,844	4.5
Fertilizers	5,766	439	20	459	4.4
Glass and ceramics	45,824	4,205	306	4,511	5.8
Leather (processed)	4,058	253	64	317	20.2
Lime and cement	34,204	3,913	2,127	6,040	35.2
Metallurgical and metal products	84,705	24,835	12,278	37,113	33.0
Oils and fats	19,520	1,603	120	1,723	7.0
Paints, varnishes, pigments	8,270	625	204	829	24.6
Paper, pulp and board	73,858	9,606	13,989	23,595	59.0
Petroleum	44,116	5,616	4,023	9,639	41.8
Plastics materials	6,822	716	303	1,019	29.8
Synthetic fibers	3,172	466	1,954	2,420	81.0
Rubber products	32,745	3,087	732	3,819	19.2
Soap, glycerin, cleaning	3,666	266	94	360	26.2
Other products	30,694	2,575	1,715	4,290	40.0
Total	661,244	102,543	52,173	154,716	33.8

gained by this LPG standby system are:

1. Continuity of plant operation in respect to fuel supply.
2. No loss of profit or product through fuel curtailment.
3. Possibility of reducing future demand charges of the utility by peak-shaving during high demand periods.
4. Interchangeability with prime fuel system.
5. Possible savings if LPG transmission system is extended. In a final analysis, all these facts must be carefully studied and evaluated.

Fuel, Steam and Electricity

Whether to purchase power or generate power requires resolution of many interrelated and complicated factors. In the process industry, the problem is increased because of two particular characteristics. The need for process steam and, in many cases, the production of combustible wastes or byproducts.

Process steam requirements can be met by purchase, in several instances, or generation or a combination of both. This adds to the problem. However, the availability for purchase is limited by the plant location and the supplied steam characteristic. Plants located remote from a major industrial area more than likely do not have utility steam available. Those located where it is available may be serviced with steam characteristics which require alteration to suit the plant needs.

Some industries produce combustible byproducts or wastes. Generally, their characteristics are such that they can only be used as fuels. Sometimes these products are burned for disposal, without useful work produced from the liberated heat. Often the material is of such low heat-value, that its conversion to electric energy would normally be considered uneconomical. Thus, the problem requires careful study for solution.

Recently, a new arrangement for obtaining purchased electric energy, and sometimes process steam, has been introduced. It is unique in that two industries, the fuel producing plant and the public utility, exchange with each other the product most efficiently and dependably produced by itself. Pacific Gas & Electric Co. at San Francisco had such arrangements with three refineries in 1950. The Esso Bayway refinery at Linden, N. J. also developed such an arrangement with the Linden station of the Public Service Co. Esso supplies fuel oil and water to the utility and the utility supplies the entire electric energy and steam needs of the refinery.

The mutual advantages of an industry-utility cooperative effort such as described are obvious. However, they cannot always be obtained. By contrast, American Cyanamid's plant at Bound Brook, N. J., could not derive benefits when it became necessary to provide additional steam and electric energy required by plant growth. In this instance, the plant was one that had always produced its own services and had no utility tie-ins. Besides the considerable cost of presently installed equipment, of high quality design, the plant engineers had to consider fuel available to the plant site. The conclusion was to expand existing facilities.

The above examples illustrate an important economic factor in purchased or plant generated power. This factor is: where should money be invested. The major items of cost in power generation are capital investment and fuel. Consider the capital investment. Capitalization of the electrical investment, whether purchased power equipment or power plant equipment, may not in itself be very critical, particularly in a large plant. However, the competition for the available capital among the many possible uses in the plant does warrant consideration.

Remember that the products of a process plant's power station are not the products the plant sells. A power company, on the other hand, which invests in a power station is investing in the production of products it produces for profit. Consider, too, the fuel charge. Except in a fuel producing process plant (either a possessed natural resource, or direct or byproduct), it is doubtful that fuel could be purchased as cheaply as it can be by the power company. The cost of power production may then exceed that of the power company.

These are some of the considerations for electric energy. Today this energy source is an important one to the process industries as shown by the data in Table XV. The table shows the amount of power purchased and generated in the various classifications of chemical process plants.

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Argintar is a licensed professional engineer in New York and New Jersey. He holds the B.E.E. degree from City College of New York and has studied mechanical engineering at NYU.

Since 1953, he has been on the staff of Pratt Institute where he teaches courses in electrical engineering and industrial plant design.

REFERENCES

"Minerals Yearbook, 1957, Vol. II," U. S. Bureau of Mines, U. S. Government Printing Office, Washington (1959).
"Statistical Bulletin, Year 1957," Edison Electric Institute, New York (1958).
"The Greater St. Lawrence Seaway Area," New York Central System, New York (1957).
"Electrical Energy Consumed: CPI vs. All Manufacturing," *Chemical Engineering* Research Report 12B-5.

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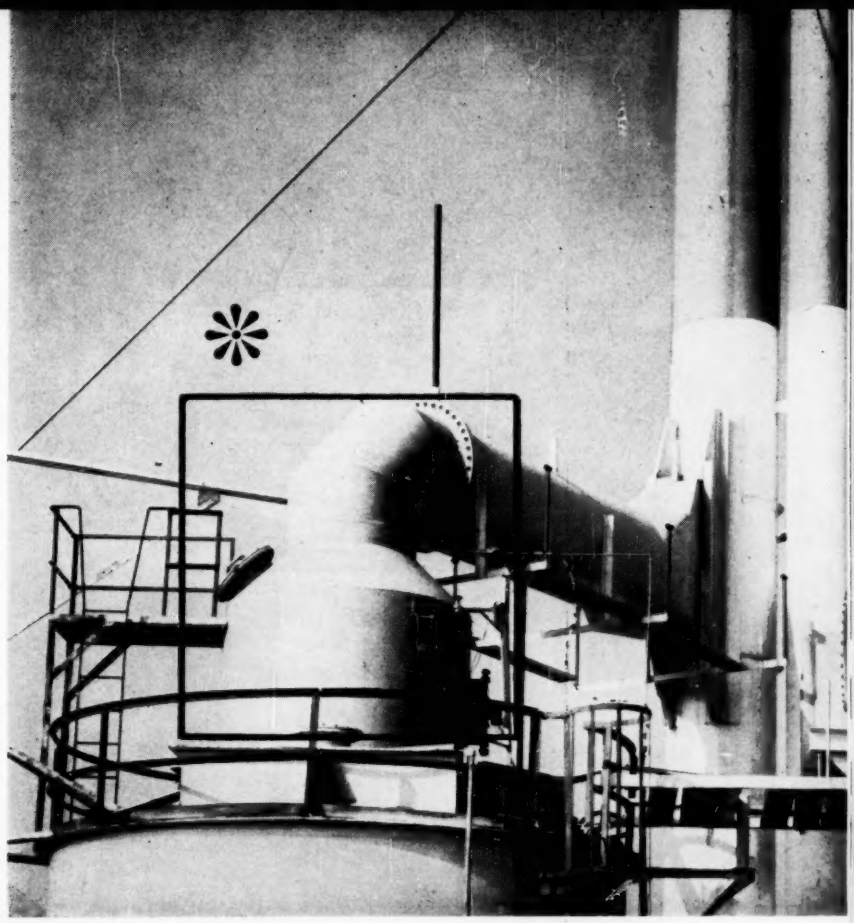
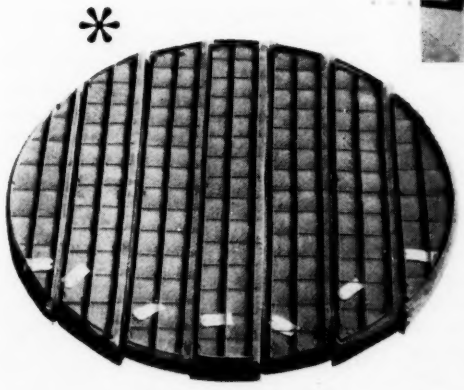




Wire-mesh demisters work best for H_2SO_4 plant. Other filters may do the job for you. Look over comparative performance data.

How Well Do Filters

Trap Stray Stack Mist?

O. D. MASSEY, Stauffer Chemical Co., Consolidated Chemical Industries Div., Houston, Tex.

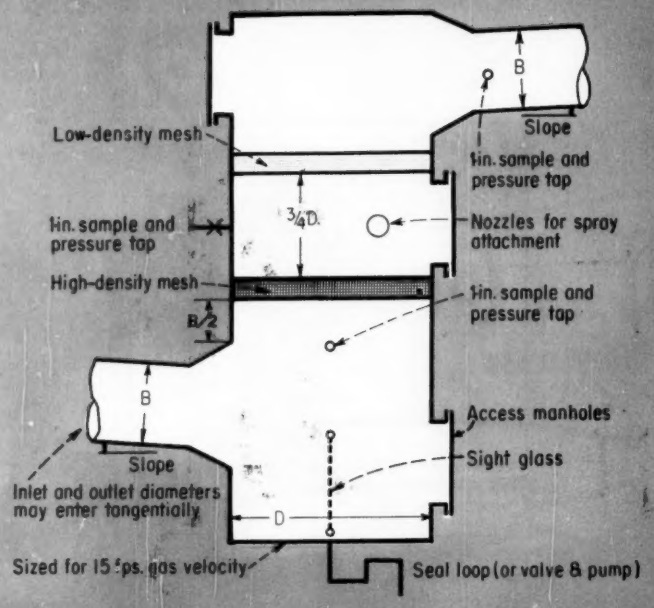
ECONOMICAL, two-stage, knitted wire-mesh filters can satisfactorily prevent emission of particulates from the stacks of plants making 98% sulfuric acid. Under average conditions, these filters gave consistently better results than five other types tested.

Sulfuric acid manufacturing facilities of the Consolidated Chemical Industries Div. of Stauffer Chemical Co. at Houston consist of four sulfur-burning contact plants and two alkylation-acid regeneration units. These facilities are located along the Houston ship channel together with a vast industrial network of oil refineries, petrochemical plants, plastic companies, and steel and paper mills.

With so many heavy industries gathered in one section of the city, even a small amount of atmospheric pollution contributed by each would amount to an intolerable condition. The fact that there is no real air pollution in Houston is evidence of the effort taken by all industries to control their processes.

This does not mean that there are

Typical Wire-Mesh Stack Filter Design



never any complaints about air pollution. Mechanical failures of equipment, and brief periods of no wind occasionally do cause complaints from a few offended neighbors.

Our plants have six tail-gas stacks ranging from 250 to 400 ft. in height; they are visible for several miles. When the least amount of visible smoke issues from the stacks, we are often suspected as the cause of any and all odors that may originate along the ship channel.

In total, the stacks exhaust approximately 2,200 cu. ft./sec. of gas to the atmosphere. Stack temperatures vary from 150 to 200 F., and velocities from 15 to 40 ft./sec. Such velocities are capable of entraining quite large particles of acid mist from the absorption towers.

At one time, tiny drops of acid blown from our stacks caused considerable paint damage, especially to automobiles in adjacent areas. This problem was solved by application of demisters; the demisters also made the plume almost invisible when producing 98% sulfuric acid, and cut the visibility of the plume when making oleum.

When oleum is manufactured, a very fine acid mist is generated. This mist defies any ordinary entrainment separator, including the ones we use. However, all the large trouble-causing particles can be filtered out. The highly visible, extremely small (probably less than 2 microns) particles left represent very few pounds of acid.

Sources of Stack Mist

Acid mist in the exit stack gases can originate from any number of sources. Poor absorption resulting from unreliable instrumentation, from an improper absorber-acid strength or temperature and from dry spots in tower packings is one offender. The unabsorbed SO_3 turned loose in the atmosphere forms H_2SO_4 mist of extremely small particle size. The mist is very noticeable.

Another cause of stack mist is moisture. In sulfur-burning contact units, combustion of dark sulfur containing hydrocarbons and other organic impurities introduces moisture into the gas stream past the drying tower. These hydrocarbons, even though they burn completely, contribute moisture nuclei necessary for acid mist formation. This can happen even though the gas never reaches the dew point as a whole. Sudden chilling on steel ductwork in the presence of SO_3 will produce a stack plume.

Mist formed by mechanical entrainment is, from our observation, the most easily removed. This is fortunate, because it is by far the most treacherous. Paint damage to automobiles or anything in its path is the result. Any device which changes the direction of gas flow will remove this stack product.

Many stack-spitting problems have been tracked down to the powdery dry iron sulfate that accumulates in stack ducts. When this material turns loose and begins to blow, it can cover large areas. Again, paint damage is the result because the powder is quite hygroscopic.

A multitude of tower variables—temperature, acid circulation rate, packing, etc.—has direct bearing on mist formation during SO_3 absorption. We have no factual data showing exactly how mist is formed in the towers, but we do know that the quantity can be as much as 10 tons/day from a single regeneration plant. We also know that the particle size of absorber mist is not necessarily small, for it is easily filtered out.

Demister Studies

Many devices designed to improve stack appearance have been investigated in our plants. Summarized below are our findings.

Cyclone Demisters—These are of limited usefulness on the exit gas. Large-size particles (20 microns) can be eliminated, but considerable power must be expended to remove smaller ones.[2]

Packed Beds—Various packed beds have been tried. Coke, quartz, rings and saddles all have value for certain applications. Adapting them to exit gas from sulfuric acid plants has drawbacks in regard to the size of vessels required, pressure drop and efficiency. Using a 1-ft. bed of 1-in. berl saddles contained in a vessel so sized that gas flow is 10 to 12 ft./sec. will stop a lot of acid mist with only about 1-

in. H_2O pressure drop. (See Table I)

Higher velocities will cause re-entrainment. Without excessive pressure drops and thicker beds, acid mist loadings have not been reduced to the 2 mg./cu. ft. desired. Generally speaking, a sulfur-burning unit, not making oleum, will have an invisible stack plume when mist loading is about 2 mg./cu. ft. or less.

Glass Fiber Filters—Considerable experimental work on the use of glass fibers as a stack-gas filtering medium has been done at the Houston plant. We found that the fibers tend to pack when wet, and although efficiency is high, it is difficult to force gas through.

Vane Filters—A vane-type filter was installed on one of our acid regeneration plants; it worked very well except for an unfortunate choice of materials. The filter consisted of ten staggered rows of parallel vanes having a teardrop shape. The vanes were about ½ in. wide and ½ in. apart, and were assembled into modules placed in a horizontal run of pipe. Shape of the vanes and their arrangement caused impaction and coalescence of small particles in the gas stream.

Using one of these filters with a face velocity of 30 ft./sec., we obtained an efficiency of 50%. (See Table II.) By increasing the velocity to 50 ft./sec., efficiencies of 90% were obtained at a pressure drop of 4 in. H_2O. (See Table III.) Exit gas contained 2 to 4 mg./cu. ft. sulfuric acid; this gave a slightly visible but acceptable plume from the stack.

Unfortunately, the filter was manufactured of molded carbon, which was not suitable for the conditions present. At a temperature of 190 F. in the presence of 98% sulfuric acid, and possibly traces of nitric acid, the carbon oxidized, weakened and collapsed. The failure, due to material selection, does not make such installations undesirable for certain applications.[4]

Lurgi Filters—These patented German filters consist of porous ceramic thimbles held in a horizontal tube sheet. The gas passes down into the tubes, and is filtered through the very fine pores between the grains. Performance of this filter is excellent. In acid regeneration plants, it has consistently reduced outlet gas loading to 1 mg./cu. ft. Pressure drop was 7 to 11 in. H_2O. For typical test results, see Table IV.

Lurgi filters are expensive to maintain. The ceramic tubes are subject to breakage; the area required is large, and so is the pressure drop. Tubes can now be obtained from American refractory

Comparative Filter Performance Data

Pressure Drop, In. H_2O	Mg. H_2SO_4/Cu. Ft. Inlet	Mg. H_2SO_4/Cu. Ft. Outlet	Efficiency, %
Packed Bed, 12-In. Layer of 1-In. Beri Saddles—Table I (Velocity: 7, 10, 12 and 20 ft./sec.)			
⅜	16.5	14.5	12
¾	18.3	6.4	65
1¼	25.8	11.6	55
3¼	46.7	28.8	38*
* Re-entrainment probably occuring			
Vane Filter, Face Velocity about 30 Ft./Sec.—Table II			
2¼	34.8	16.9	51.4
2	14.2	6.8	51.8
2	28.6	5.2	81.8
2	35.2	3.3	90.6
Vane Filter, Face Velocity About 50 Ft./Sec.—Table III			
4	26.3	2.3	91.4
4	18.8	4.1	78.2
Lurgi Filter, Velocity About 5 Ft./Sec.*—Table IV			
9	15.8	1.5	90.5
10	59.6	2.8	95.3
10	54.9	0.8	98.6
8	21.4	6.0	72.0
8	17.5	4.5	75.0
* Filter tube sheet area of 116 sq. ft.			
Wire-Mesh Filter, 2-Stage, Velocity 12 to 15 Ft./Sec.—Table V			
1	8.8	0.70	92.5
¾	4.1	0.74	82.0
1¼	13.8	0.92	93.4
1¼	66.9	0.77	98.9
1½	32.5	0.98	97.0
1½	13.0	0.76	94.1

Knitted Wire-Mesh Filter Specifications†—Table VI

Density, Lb./Cu. Ft.	Surface Area, Sq. Ft./Cu. Ft.	Free Volume, Approx. %	Thickness,* In.
14	120	96	4
12	115	97	4
9	85	98	4, 6
7	65	99	6
5	45	99	6

*Thickness varies with efficiency desired and allowable pressure drop.

† Wire sizes available from 0.003 to 0.016 in. Usually 0.011 in. used; above data for 0.011 in.

manufacturers and, generally, are bonded better than those made in Germany.

Knitted Wire-Mesh Filters—By our observation, the most practical filter for exit gas from sulfuric acid plants is the knitted wire-mesh filter, used in two stages. These filters are being made by several manufacturers, whose brochures are very complete.[5] Claims of the manufacturers have been largely verified by our plant installations.

Table VI gives typical specifications. The filters are unique in their large surface area, large free volume and light weight. We prefer to use two stages, the lower stage being high-density mesh, 12 or 14 lb./cu. ft., and the upper mesh being 5 or 7 lb./cu. ft.

Each pad varies from 4 to 8 in. in thickness. Stages are generally separated by a distance equal to three-fourths of the vessel diameter. (See illustration p. 144)

Theory of operation of such filters has been reported in the literature by several people.[1, 3] However, it should be noticed here that in the correct range of velocity, a layer of entrained liquid is held up within the filter's wires. This liquid scrubs the gas stream, increases its velocity and, hence, increases the impaction of fine particles.

As this volume of liquid increases, it over-balances the pressure of the gas stream and drips out. Too high a velocity will reentrain the scrubbing liquid. Ideal velocity for each application depends on the nature of the gas and the liquid entrained.

For sulfuric acid stacks, our experience indicates that proper velocity in the duct approaching the filter is 15 to 18 ft./sec. The velocity can drop as low as 10 or 11 ft./sec. and the efficiency will remain acceptable. If desired efficiency cannot be obtained at these velocities, thicker or more dense wire pads may be used. This will, of course, increase back pressure; each additional in. H_2O back pressure will require 0.158 hp./(1,000 cu. ft.) (min.) of gas flowing.

One three-stage filter having a third, smaller-diameter pad wetted by spray nozzles was tried. We hoped that the resultant high velocity and scrubbing action would absorb the fumes from an oleum tower. The unit was not effective; oleum mist escaped, and the high optical density of the stack plume was scarcely altered.

Table V shows some typical results obtained using wire-mesh filters. However, the tables do not show that the stack plumes are practically invisible when making 98% acid, nor do they show that claims for damage due to acid spray have practically ceased.

In general, it can be said that a two-stage wire-mesh filter will reduce acid content of stack gas to 1 or 2 mg./cu. ft. at a pressure drop of 1.5 to 2 in. Actual efficiency depends on inlet loading.

Materials of Construction

Wire-mesh filters made of several alloys are in use at Houston, the oldest for almost two years. Our experience with corrosion is limited to this extent. Made of Carpenter 20 alloy, the oldest filter's lower stage showed considerable corrosion after 14 months. But, it appears that most of the damage may have been caused by weak sulfuric acid during some plant-scale experiments.

Next filter installed—in an acid regeneration unit—was made with Hastelloy B wire mesh. Unfortunately, this alloy, although immune to 98% sulfuric acid, will not tolerate traces of nitric acid. Sulfur-burning sulfuric acid plants evolve traces of nitric acid on the order of a few parts per million, but regeneration plants have considerably more nitric in the stack drip. In any event, three months of operation destroyed the lower Hastelloy B pad; the upper pad, made of Carpenter 20 alloy, was not noticeably harmed.

In one of our sulfur-burning contact plants, a Hastelloy C wire-mesh filter, on inspection after one year's service, appeared in perfect condition. It is still in service, and is performing perfectly after nine months of additional full-time operation.

The relatively inexpensive alloy 20 appears to be the cheapest and most practical material to use, assuming that the corrosion experienced in one case may be due to other factors. In all cases, we used Carpenter 20 grids above and below each filter pad. The grids are ¼-in. dia. rods, welded to the edges of 1x⅛-in. flat bars; bars and rods are spaced about 5 in. apart. No appreciable corrosion has occurred on the grids but, of course, corrosion and erosion that would weaken a 0.011-in. wire would hardly bother a ¼-in. rod.

Other Cleaning Methods

Other methods of getting rid of the stack plume are available. Chemical absorption methods, such as ammonia units, involve rather large plants with a high capital investment and a very slow return. Electrostatic precipitators have the same drawbacks.

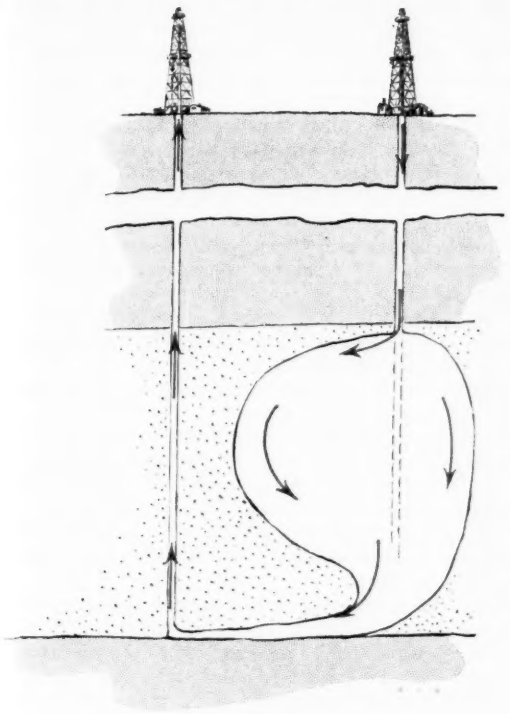
Our research department continues the study of stack problems, and may come up with a better answer in the future. At present, however, the simple two-stage mesh filter is eliminating all the larger particles from our stack gas, and is giving our units a very acceptable appearance.

O. D. MASSEY has been associated with Stauffer since 1939, first as chemist at Houston, then as Plant Manager at Fort Worth, and currently as Plant Manager of the Houston facilities. Massey received his BS,ChE from New Mexico College of Agriculture and Mechanics Arts State College.

This article is based on a paper delivered at the Manufacturing Chemists Association conference dealing with air and water pollution abatement, March 1959.

REFERENCES

1. Friedlander, S. K., *Ind. Eng. Chem.*, 50, 1161 (1958).
2. Hareley, H., "Particulate Clouds, Dusts, Smokes and Mists," D. Van Nostrand Co., Inc., New York, 285-287 (1957).
3. Landuhl, H. D. and R. G. Hermann, *J. Colloid Sci.*, 4, 103 (1949).
4. Technical Brochure 1CP-287, "Karbate Type MV Scrubbers," National Carbon Co., Cleveland, Ohio.
5. Technical Brochure, Bul. No. 15, Otto H. York Co., Inc., East Orange, N. J.
Technical Brochure, Cat. No. 57, ACS Disentrainer Div., American Copper Sponge Co., Inc., Providence, R. I.
Technical Brochure, Bul. No. 111, Schuyler Mfg. Corp., North Arlington, N. J.



Engineering the Two-Well Method of Solution Mining

Solution mining with two wells has certain definite advantages over the one-well method. Here are some of the simple techniques that can lead you to successful completion.

J. K. HENDERSON, Consulting Engineer, Tulsa, Okla.

SOLUTION mining has proved a safe, efficient and inexpensive method for recovering water-soluble minerals from underground deposits. Basically, the process consists of drilling a well into the deposit, injecting hot water or steam down the annulus, and recovering the dissolved or melted minerals up the tubing.

Even more efficient is the two-well system of solution mining. In this process, two separate offset wells are drilled, water is pumped down one well, and enriched brine produced from the other.

Complete procedure for setting up a two-well system is too complex to be covered comprehensively in a single article. Too many variables exist, and each well has its own individual characteristics that must be treated accordingly. Many times, unexpected difficulties require modification of completion procedures.

It's important to employ sound engineering principles in establishing any two-well system. Preliminary planning is essential to complete the wells most efficiently or, for that matter, to have the entire project successful. In general, this preplanning is broken down into four essential steps:

- Location of wells, with regard to direction and distance from each other.
- Drilling of wells.
- Pipe and cementing program.
- Well completion and subsurface interconnection.

Well Location: All Important

Many factors enter into selecting the project's site. First, and all important, is the geological location of the material to be mined. A second factor is availability of the land where you'll conduct the mining—at an economical figure. Third factor is the pattern of natural formation stresses and weaknesses, insofar as they can be determined.

At this point, the geologist and the well engineer should confer to determine the optimum location of initial wells. This is a very important step because, since the wells are not interconnected naturally, artificial fractures must be produced during the completion procedure.

Formation fracturing has long been practiced in the oil fields as a well stimulation technique. It's done by injecting fluids into the formation at high pressure, the pressure forcing the rock apart at natural fractures or weaknesses.

Naturally, the faults and stresses present in the formation contribute to, and determine the fracture pattern produced. Hence, it's important to assemble all possible geologic data to help the engineer predict what form and direction the fracture will take, so the proposed wells may be located accordingly.

J. K. HENDERSON is a consulting engineer in solution mining and the petroleum industry. A graduate of the U. of Oklahoma, Henderson has experience in both oil well drilling and production. For 10 years he was with Dowell, Inc. Serving as their chief engineer, Henderson designed and executed the first two-well system of solution mining for the Dow Chemical Co.

Base the distance betwen the wells on two things: They should be far enough apart to provide economical, extended recovery; yet not so far from each other that interconnection by fracturing is impractical. Depth at which the mineral deposit is located is also a factor in this consideration. In general, locate the wells not less than 300 ft. nor more than 600 ft. apart.

Leave Drilling to a Contractor

For best results, secure the services of an established, qualified drilling contractor. Give him the drilling requirements, including specifications for depth, remaining within three degrees of vertical, etc. Complete a standard drilling contract, based upon the footage drilled. Then, leave him alone to complete the job as he is accustomed to doing it.

In most cases, drilling can be interrupted to run logs or secure cores; however, unnecessary requirements, such as drilling an oversize hole, increase costs far out of proportion to any additional benefits obtained. Too elaborate a mud program can also add unnecessary expense.

Select the Proper Pipe and Cementing Program

Selecting the proper pipe program for a well is important, not only from the standpoint of keeping initial costs to a minimum, but also keeping in mind minimizing long-term operational and remedial expenses. Choice of surface and intermediate strings is governed by local conditions. In choosing the production string, take care to provide sufficiently heavy pipe to withstand the elevated hydraulic pressure it will be subjected to during later fracturing operations.

It's possible to complete the well using a lighter grade pipe and to inject the fracturing fluids through a tubing string, using a pressure-retaining tubing packer to confine the high pressures in the zone being fractured. This procedure isn't recommended, as there's always danger of damaging casing, requiring costly remedial repairs.

In the long run, it is less costly to use heavier casing, with the following advantages:

- Thicker pipe wall gives longer life.
- Saves cost of packer and tubing.
- Saves rig time in placing and removing packer.

In determining pipe specifications for a well, maximum pressure limitations may be set from estimated maximum fracturing pressures anticipated during completion. Surface injection pressure may be calculated from the following simple formula:

Depth (ft.) × 1.2 (psi./ft.) + (approx.) 600 psi.
− hydrostatic head of breakdown fluid (psi.)
= surface breakdown pressure (psi.)

If "breakdown" pressures encountered during later fracturing operations are materially higher than those indicated by the above formula, halt the job at once rather than subject the casing and formation to excessive pressure. In most cases, abnormal conditions causing the high pressure can be located and remedied before proceeding further with the fracturing job.

Completion and Interconnection: The Payoff

The fracturing operation (because wells with naturally connecting flow channels are rarely encountered) is the most important step in the entire drilling and completion procedure. Operating efficiency of the well and ultimate profit return from the system, all depend upon the success of the fracturing operation you undertake.

In planning the completion program, take the following four factors into consideration:

- Control fracturing operations as much as possible, to provide a breakthrough at the correct level.
- If the fracture fails to develop at the desired point or in the proper direction, take steps to divert further fracturing materials into the proper section of the formation.
- In the event that it's impossible to connect the two wells, it should be possible to complete them individually as single-well systems.
- Carefully plan completion techniques so as to minimize future maintenance costs.

Controlling the point of breakthrough during a fracturing job is greatly facilitated by proper cementing techniques. Set the pipes so that only the portion of the formation where the fracture is desired is exposed to the breakdown pressure. Select this breakdown point only after careful study of geologic data and subsurface well conditions.

Following the fracturing job, conduct sub-surface injectivity surveys to make sure the fracture took place at the desired level. If, for some reason, the fracture occurred at some other point in the well bore, additional fracturing stages may be performed. Numerous techniques are available for diverting fracturing materials away from a previously fractured zone and, in most cases, you can obtain the desired fracture on the second try.

Immediately after the initial breakthrough is the most critical time in the successful establishment of a fracture. Large volumes of fluid must be pumped through continuously, until the producing well becomes responsive to the injection well. At this time, a satisfactory low pressure channel will have been established and the system is ready for operation.

Even with the utmost care, and utilization of the most skilled techniques, there will be a small percent of wells that will not connect. Usually, some formation peculiarity, such as the presence of an unexpected fault, is responsible for such difficulties.

In such a case, don't spend over 24 hr. trying to establish a high-pressure connection. There are two reasons for this: First, the odds for obtaining a connection after this length of time are very poor and, second, if you obtained such a connection after 24 hours, pumping time necessary to dissolve out sufficient minerals to convert to a low-pressure connection is almost prohibitive in cost.

In the event that it is impossible to establish interconnection between the two wells, they can then be converted to conventional single-well systems, operating independently of each other. Principal disadvantage of a single-well system over a two-well system is increased maintenance costs due to pipe damage caused by corrosion and roof cave-ins.

Even these difficulties are minimized, however, by proper planning and preventive measure. Although all wells will not allow the same pattern, such future maintenance problems should be given careful consideration during the planning and completion stages of the well.

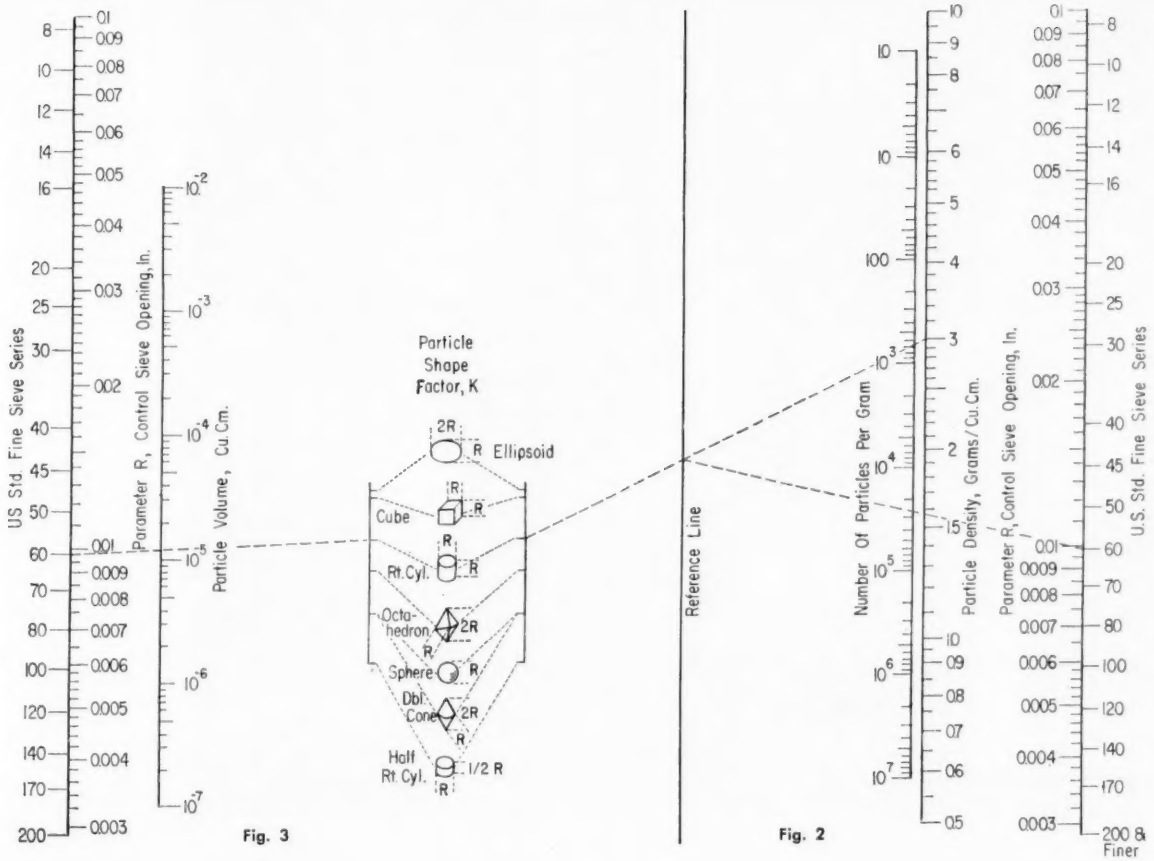


Fig. 3 Fig. 2

Charts to help you . . .

Estimate Particle Properties

With these charts you can quickly find specific surface, number of particles and particle volume when material density and particle shape are known.

GEORGE V. VOSSELLER, Nilok Chemicals, Inc., Lockport, N. Y.

WE SOMETIMES need physical properties of particles when experimental data or extensive calculations are unavailable. The three alignment diagrams in this article enable you to estimate specific surface, particle volume and number of particles for a 1-gm. sample. All you need in using the diagrams is material density and an estimated particle shape. These diagrams, although of low accuracy, have been helpful in various abrasives problems and should also prove practicable for other work with particles.

The general formula for Fig. 1, based on 1 gm., is:

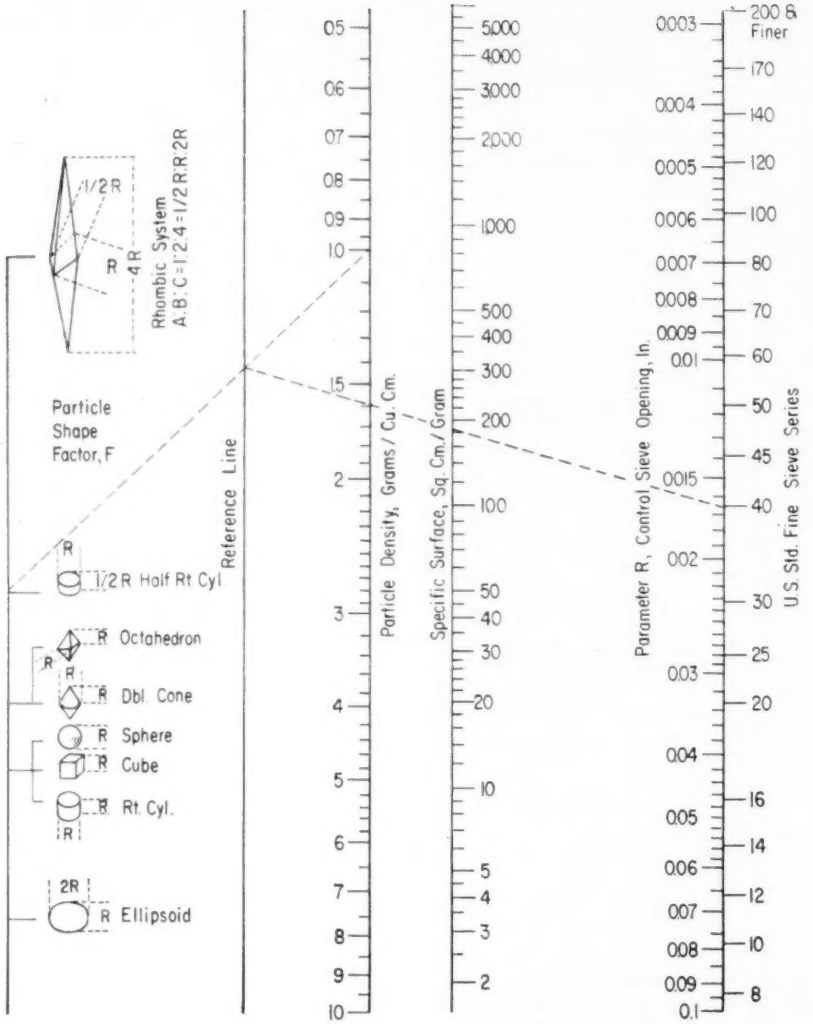


Fig. 1

$$S_t = \frac{A_p}{V_p \rho} \quad (1)$$

where S_t is total surface area, A_p is particle area, V_p is particle volume and ρ is material density. If, for any geometric shape, the area and volume are expressed as functions of some dimension R, then

$$S_t = \frac{F}{R\rho} \quad (2)$$

where F is the area-to-volume ratio, or particle shape factor. The parameter R, shown on the diagrams as sieve opening size in inches, is of course the controlling factor for particle size in given fractions.

A number of basic geometric particle shapes are indicated on the shape factor axis of each diagram. Other points may be added for convenience.

The general formula for Fig. 2 is

$$N = \frac{W_t}{W_p} \quad (3)$$

where N is number of particles in the sample, W_t is total weight of the sample and W_p is particle weight. When 1 gm. is substituted for W_t and the dimensions expressed in terms of R, the formula becomes:

$$N = 1/KR^3 \quad (4)$$

Here, K is a constant for a given geometric shape.

Fig. 3, the chart for the volume of a particle, is derived from the basic equation for volume of a given geometric shape.

$$V_p = KR^3 \quad (5)$$

In general, these diagrams will tend to estimate on the low side because of shape inconsistencies, surface irregularities and grading.

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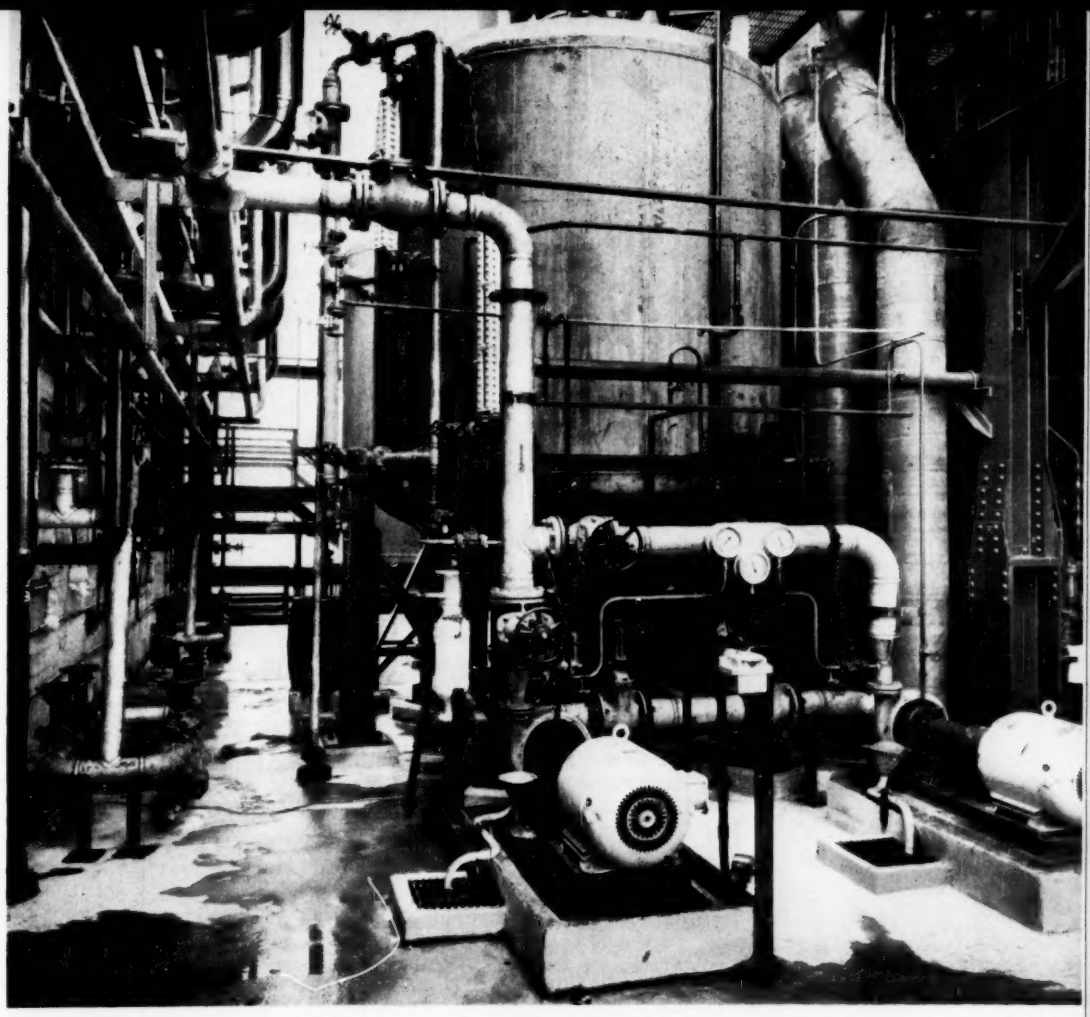
REFERENCES

1. Brown G.C., *et al.*, "Unit Operations," Wiley, New York (1950).
2. Douglass, R.D., and D.P. Adams, "Elements of Nomography," McGraw-Hill, New York (1947).
3. U.S. Dept. of Commerce, "Simplified Practice Recommendation 118-50," June 1, 1950.



CE Refresher

How to Solve Problems in Fluid Flow

When turbulent or laminar flow occurs, find driving potential, flow rate or pipe diameter easily by following these step-by-step methods.

JESSE COATES and BERNARD S. PRESSBURG, Louisiana State University, Baton Rouge, La.*

USING the fluid flow relations developed in our previous article (*Chem. Eng.*, June 15, 1959, pp. 185-190), let's consider some typical problems which occur in industry.

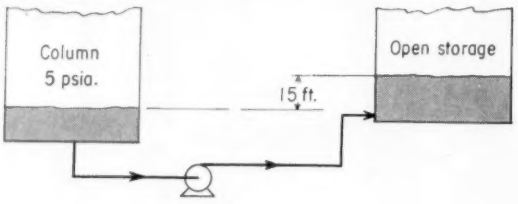
Probably the most frequently encountered flow problem is to determine the driving potential required to cause a fluid to flow at a specified rate between designated terminals through a pipe of known size.

In this situation, knowing the flow rate and the pipe dimensions, we can determine flow resistance and, from this, the necessary potential. If flow is laminar, the calculations are easily performed because Poiseuille's equation applies. For turbulent flow, empirical correlations relating friction factor to Reynolds number apply.

In either case, we must use empirical information to determine the frictional resistance of valves and fittings. Hence, for any pipe size, we add to the straight run of pipe an equivalent length of pipe that produces the same pressure drop as the valves and fittings. An example best illustrates this procedure.

*To meet your authors, see *Chem. Eng.*, May 18, 1959, p. 182.

Find Flow Resistance of Pipe and Fittings



Problem 1—Turpentine at 140 F. is pumped from the bottom of a fractionating column to a storage vessel as shown in the sketch. Schedule 40, 2-in. steel pipe connects the two vessels. Pipe line contains 300 ft. of straight pipe, one globe valve, fifteen 90° elbows and three side outlet tees. Density of the turpentine is 51.6 lb./cu.ft. and viscosity is 0.82 centipoise. Inside diameter of pipe is 2.067 in. and cross section is 0.0233 sq. ft.

If flow is 30 gpm., what loss in energy does friction cause and what theoretical horsepower must the pump supply?

Step 1—To find the Reynolds number, first calculate the fluid velocity.

$$v = \frac{30}{7.48 \times 60 \times 0.0233} = 2.96 \text{ fps.}$$

$$N_{Re} = Dv\rho/\mu$$

$$N_{Re} = \frac{2.067}{12} \times 2.96 \times 51.6 \times \frac{1}{0.82 \times 0.000672}$$

$$N_{Re} = 46{,}200$$

Step 2—Calculate the roughness ratio ϵ/D and then find friction factor from Fig. 2.

$$\epsilon/D = 0.00015/(2.067/12) = 0.00087$$

From the roughness ratio and Reynolds number, we get the friction factor from Fig. 2. Hence, $f = 0.006$.

Step 3—Using Fig. 1 and Table I, find the equivalent length of fittings and valve. For this problem, equivalent length of line and fittings is 483 ft.

Step 4—Since flow is turbulent, apply the Fanning equation to calculate friction losses.

$$F = \frac{4 \times 0.006 \times 483 \times (2.96)^2}{64.4 \times 2.067/12} = 91.5 \text{ ft.-lb./lb.}$$

Step 5—Calculate the mechanical work by applying the mechanical energy balance. In this problem, remember that $(v_2^2 - v_1^2)/2g$ and $\int PdV$ equal zero.

$$-W = (Z_2 - Z_1) + P_2V_2 - P_1V_1 + F$$

$$-W = 15 + \frac{(14.7 - 5)(144)}{51.6} + 91.5$$

$$W = 133 \text{ ft.-lb./lb.}$$

Step 6—Calculate horsepower.

$w = 50$ gpm. $\times$ (51.6/7.48) lb./gal. = 345 lb./min.

$HP = wW/33{,}000$

$= (345)(91.5)/33{,}000 = 1.39\ HP$ at 100% efficiency

Several points in this example should be noted. First, it is necessary to determine the type of flow. Since the Reynolds number is above 2,000, the flow is turbulent. Hence, we use the Fanning equation since Poiseuille's equation is not applicable.

Next, the length term in Eq. (14) includes not only the straight pipe, but also the influence of valves and fittings required to control the flow or to change its direction. Also the length term includes the influence of metering instruments and similar obstructions to flow. All offer resistance to flow, just as does the fluid in the straight pipe. This resistance may be desirable,

Determine Equivalent Length of Fittings

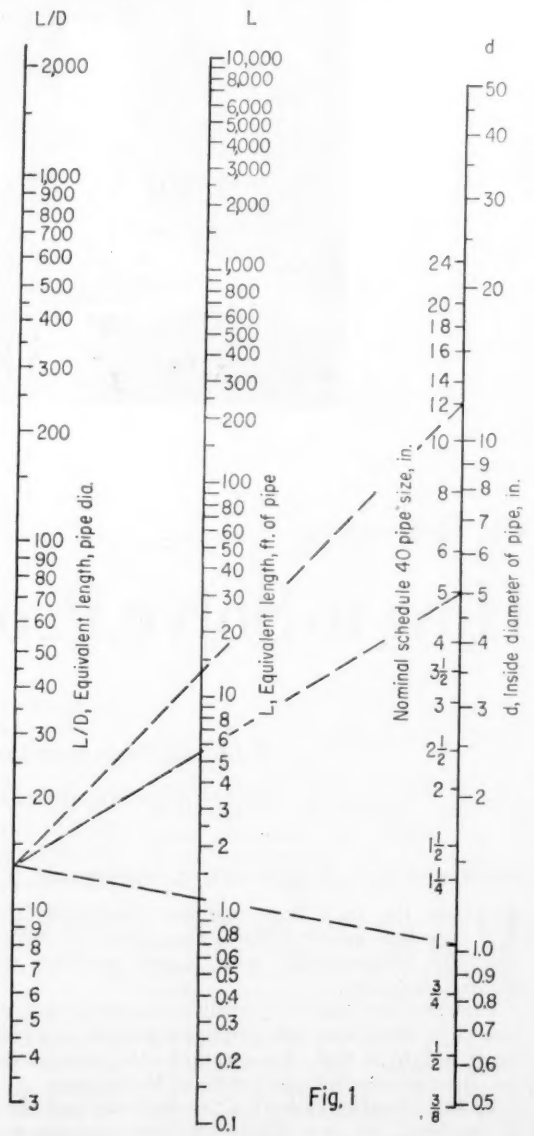
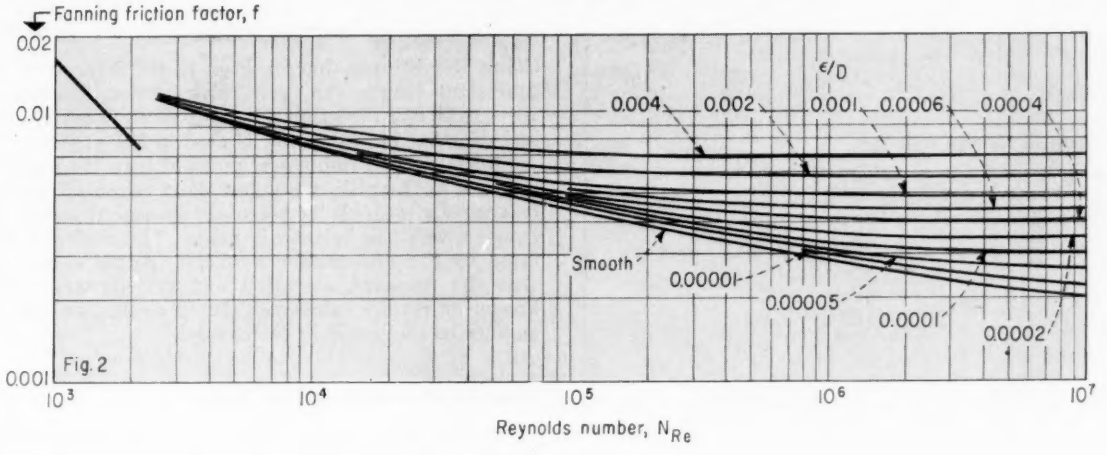


Fig. 1

Crane Co.

Pipe Roughness Affects Friction Factor in Turbulent Flow Range



Equivalent Length in Pipe Diameters of Valves and Fittings—Table I

			L/D
Globe valves: conventional			
No obstruction in seat		Fully open	340
With wing or pin-guided disk		Fully open	450
Globe valves: Y-pattern			
No obstruction in seat, stem 60° to pipeline		Fully open	175
No obstruction in seat, stem 45° to pipeline		Fully open	145
Gate valves			
Conventional wedge disk, double disk, plug disk		Fully open	13
		¾ open	35
		½ open	160
		¼ open	900
Pulp stock		Fully open	17
		¾ open	50
		½ open	260
		¼ open	1,200
Conduit pipeline		Fully open	3
Check valves			
Conventional swing	0.5 psi.*	Fully open	135
Clearway swing	0.5 psi.	Fully open	50
Globe lift or stop	2.0 psi.	Fully open	same as globe
Angle lift or stop	2.0 psi.	Fully open	same as angle
Inline ball, vertical	2.5 psi.	Fully open	150
Inline ball, horizontal	0.25 psi.	Fully open	150
Butterfly valves,			
6-in. and larger		Fully open	20
Fittings			
Standard elbow 90°			30
Standard elbow 45°			16
Long radius elbow 90°			20
Street elbow 90°			50
Street elbow 45°			26
Square corner elbow			57
Standard tee, flow through run			20
Standard tee, flow through branch			60
Close pattern return bend			50

*Minimum calculated pressure drop across check valves to provide sufficient flow to lift disk fully.
Data for this table from Ref. 1.

Use These Equations in Your Calculations

Volumetric Flow Rate

$$Q = v \times S \qquad (3)$$

Mechanical Energy Balance

$$\frac{Z_1 g}{g_c} + P_1 V_1 + \frac{v_1^2}{2g_c} + \int_{V_1}^{V_2} P\,dV - W = \frac{Z_2 g}{g_c} + P_2 V_2 + \frac{v_2^2}{2g_c} + F \qquad (4)$$

Driving Potential for Laminar Flow
Poiseuille's law

$$F = \frac{\Delta P_F}{\rho} = \frac{32\mu L v}{g_c D^2 \rho} = \frac{128\mu L Q}{\pi g_c D^4 \rho} = \frac{128\mu L w}{\pi g_c D^4 \rho^2} \qquad (9)$$

Resistance in Laminar Flow
Poiseuille's law

$$R = \frac{F}{w} = \frac{128\mu L}{\pi g_c D^4 \rho^2} = \frac{\text{ft.-lb. force/lb. mass}}{\text{lb. mass}} \qquad (12)$$

Driving Potential for Turbulent Flow
Fanning equation

$$F = \frac{4fLv^2}{2g_c D} = \frac{32LfQ^2}{\pi^2 g_c D^5} = \frac{32flw^2}{\pi^2 g_c D^5 \rho^2} \qquad (14)$$

Resistance in Turbulent Flow
Fanning equation

$$R = \frac{F}{u} = \frac{4fw}{2g_c\,(\pi/4)\,D^2\rho^2} \times \frac{L}{\pi D^2/4} \qquad (15)$$

Pipe Roughness Limits Friction Factor
Empirical equation for turbulent flow

$$f = a_1 (N_{Re})^a \qquad (20)$$

Reynolds Number Governs Friction Factor
Empirical equation for turbulent flow

$$f = a_2 (N_{Re})^b \qquad (21)$$

as in the case of valves, or it may be unavoidable, as in the other devices.

Accepted procedure is to express resistance of these components as an equivalent length of straight pipe which causes the consumption of the same quantity of driving potential as does the actual device for the same flow rate. Like the friction factor, evaluation of this resistance requires empirical information. Standard practice is to correlate the data as a number of pipe diameters. This number proves to be substantially independent of the pipe size for each type of fitting. Empirical information[1] for equivalent lengths is shown in Fig. 1. The equation for this relation is:

$$L_{Eq.} = (\text{a constant}) \times D \qquad (22)$$

Using the information in Fig. 1, we determine the equivalent length for each valve, fitting, change of cross section or direction. The total of all these lengths, including the straight pipe, is used in Eq. (14).

Finally, to determine how much energy the pump is required to furnish, we apply the mechanical energy balance Eq. (4). It is necessary to select points between which the balance is made. The choice is dictated by the information available, being so selected that the pressure, elevation and velocity are either known or readily calculated. In this case, we use the surface of the liquid in each vessel.

How to Determine Flow Rate

Another very common situation is the reverse of the previous example. Here, the potential motivating the flow through a specified pipe is known. How do we predict the desired flow rate? Inspection of Eqs. (9) and (12) shows that a direct solution is available for streamline flow, but not for turbulent flow. In turbulent flow, the resistance term depends on the unknown flow. Hence, we cannot evaluate resistance until flow rate is known.

A trial-and-error solution can be carried out for this case by assuming velocities and calculating the corresponding potential. We repeat the calculations until a value is found for the required potential which is exactly the same as the available potential. However, to avoid trial-and-error calculations, the information shown in Fig. 2 can be rearranged and replotted as shown in Fig. 3. Ordinate of this new plot is f, as before, but the abscissa is $N_{Re}(f)^{0.5}$ instead of N_{Re}. If we solve Eq. (14) for $(f)^{0.5}$ and substitute the resulting expression in the coordinate for the abscissa, we get $(D\rho/\mu)\,(2g_c DF/4L_{Eq.})^{0.5}$. This grouping is known as the Karman number N_K and can be evaluated without knowledge of the flow rate, while the Reynolds number cannot. Hence, we can calculate f and solve Eq. (14) for the velocity. The next example illustrates this procedure.

Problem 2—What quantity of water will flow through an equivalent length of 500 ft. of 1½-in. Schedule 40 steel pipe when the pressure drop is 15 psi.? At 80 F., viscosity of water is 0.882 centipoise and density is 62.2 lb./cu.ft.

Step 1—Calculate Karman number.

$$N_K = D\,\frac{\rho}{\mu}\left(\frac{2g_c\,DF}{4L_{Eq.}}\right)^{0.5}$$

$$N_K = 5{,}450$$

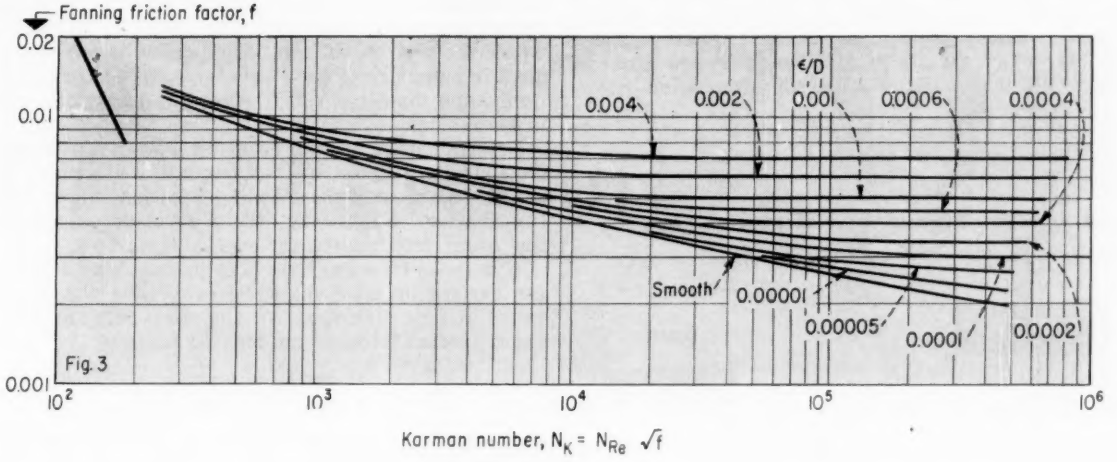
Step 2—Find pipe roughness (*Chem. Eng.*, June 15, 1959, p. 190) and calculate roughness ratio. Then read friction f from Fig. 3.

$$\epsilon/D = 0.00112$$

$$f = 0.0058$$

Step 3—Since flow is turbulent, use Fanning equation to calculate velocity and then find flow rate.

When Flow Rate Is Unknown, Use Karman Number to Find Friction Factor



$$F = 4fLv^2/2g_cD$$

$$\frac{15 \times 144}{62.2} \quad \frac{4 \times 0.0058 \times 500 \times v^2}{2 \times 32.2 \times 1.61/12}$$

$$v = 5.10 \text{ fps.}$$

$$Q = 5.10 \times 0.01414 = 0.0072 \text{ cfs.} = 32.3 \text{ gpm.} = 16{,}200 \text{ lb./hr.}$$

How to Select Pipe Diameter

One of the most common problems in fluid flow is selection of pipe diameter. Study of the mechanical energy balance Eq. (4) and of the Fanning equation Eq. (14), shows that two cases must be recognized. These are:

1. Minimum diameter that will give a resistance sufficiently low to allow the desired flow potential under the available potential.

2. Economic optimum diameter that will give the lowest total cost for the pipe and pump considering investment and operation.

When the available potential is known and flow rate is specified, determination of the minimum pipe size can be made by using Eq. (9) or (14). Direct solution for pipe diameter is possible only if streamline flow prevails. Streamline flow is probable only if fluid is viscous or available flow potential is very low.

In turbulent flow, the resistance cannot be calculated directly because it includes the unknown diameter as well as the friction factor. Accordingly, Eq. (14) is best solved by trial-and-error. We could replot the f and N_{Re} values to eliminate the unknown diameter. However, the magnitude and wide variation in the range of values required to cover the probable limits over which the diameter would vary makes this procedure unsatisfactory.

In contrast, the trial-and-error solution is readily attained because of the strong dependence of required potential on pipe diameter which varies essentially as D^5 and, also, to the relatively few pipe sizes available. The number of trials may be minimized by the following approaches which are illustrated in Problem 3.

1. Estimate the friction factor. For water, use $f = 0.004$; for gases, $f = 0.0035$ and for nonviscous organics, $f = 0.005$. Then, solve for D in Eq. (15).

2. Set a reasonable velocity as shown in Table II and calculate the first trial diameter by Eq. (3).

Nomenclature

- a_1 = Constant, dimensionless.
- a_2 = Constant, dimensionless.
- A = Shear area, sq. ft.
- D = Pipe diameter, ft.
- F = Friction, ft.-lb./lb.
- f = Fanning friction factor, dimensionless.
- g = Local acceleration of gravity, ft./sec.²
- g_c = Gravitational conversion factor, 32.2 ft./sec.²
- L = Pipe length, ft.
- N_K = Karman number, dimensionless.
- N_{Re} = Reynolds number, dimensionless.
- P = Pressure, lb./sq. ft.
- Q = Volumetric rate of flow, cfs.
- R = Hydraulic resistance, (ft.) (lb. force)/(lb. mass)².
- r = Hydraulic resistivity, (lb. force) (ft.)²/(lb. mass)².
- S = Transverse or flow area, sq. ft.
- V = Fluid volume, cu. ft./lb.
- v = Average linear velocity, fps.
- w = Weight rate of flow, lb./sec.
- W = Mechanical work, (ft.) (lb. force)/(lb. mass).
- Z = Vertical distance above reference level, ft.
- ϵ = Pipe roughness, ft.
- μ = Viscosity, lb./sec.-ft.
- π = Numerical constant = 3.1416.
- ρ = Fluid density, lb./cu. ft.
- τ = Shear stress, lb. force/unit shear area.

Velocities for Fluids in Circular Pipes—Table II

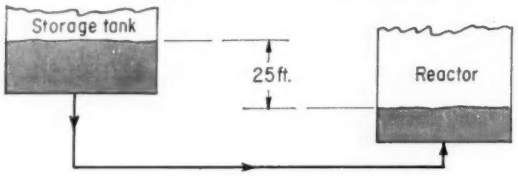
Water	3 to 20 fps.
Nonviscous organic liquids	2 to 10 fps.
Viscous liquids	1 to 3 fps.
Gases or vapors	30 to 300 fps.

These velocities give reasonable pressure drops whose magnitude is 1 to 5 psi. for every 100 ft. equivalent length of piping.

3. Use an approximate mathematical statement of the friction factor as suggested by Eq. (20) or (21).

Use the pipe diameter obtained as a first estimate by any of the three methods to calculate the energy requirement as shown in Problem 1. The smallest diameter which gives a potential requirement equal to or less than that available is the correct solution.

Find Smallest Pipe to Give Required Flow



Problem 3—What is the smallest size pipe that can connect the storage tank to the reactor to give a flow of 10 gpm. of methanol? Schedule 40 steel pipe and fittings have an equivalent length of 100 ft. At 68 F., methanol has a density of 49.5 lb./cu. ft. and a viscosity of 0.6 centipoise.

Let us estimate the required pipe size by each of the three methods.

Method 1—For the organic liquid methanol, assume the friction factor f equals 0.005. Substitute this value and the other quantities in the Fanning equation.

$$F = \frac{4fLQ^2}{2g_c D^5(\pi/4)^2}$$

Solve equation for pipe diameter D. Value of D is 0.76 in. which corresponds to a pipe dimension between ¾- and ½-in. pipe.

Method 2—Assume that the velocity for nonviscous organic liquids equals 5 fps. Solve for cross-sectional area S in Eq. (3). Area equals 0.00446 sq. ft. which corresponds to a pipe size between ¾- and 1-in. pipe.

Method 3—Use an approximate expression for the friction factor. Estimate pipe roughness to be about 0.001 and Reynolds number to range between 10^4 and 10^5 which is normal for organic liquids.

$$f = 0.037/(N_{Re})^{0.164}$$

For this problem, $N_{Re} = 4w/\rho D\mu = 3{,}455/D$. Substitute this friction factor in the Fanning equation given in Method 1 and use the necessary numerical quantities for the other items. Solve for pipe diameter which is 0.595 in. This size falls in the range of ½-in. and ¾-in. pipe.

Using the Fanning equation, calculate the friction loss F for each of the standard pipe sizes and compare with the allowable friction head of 25 ft.

Pipe Size	Inside Diameter	Velocity	Reynolds Number	Roughness Ratio	Friction Factor	Friction
In.	In.	Fps.				Ft.
1	1.049	3.72	40,000	0.0018	0.0068	6.7
¾	0.824	6.02	50,400	0.0022	0.0070	22.8
½	0.622	10.58	66,600	0.0029	0.0070	940.0

Hence, the required pipe size is ¾-in. which gives a friction loss of 22.8 ft. compared with an available head of 25 ft.

How Pipe Size Affects Costs

Large pipes have low resistance and require a smaller potential for a specified flow rate. Thus, pump, motors and power consumption are smaller. Hence, the larger the pipe investment, the smaller is the investment in pump drives and the lower is the cost of operation. Pipe diameter which gives the least total cost is desirable.

Determination of this economic optimum diameter is primarily a matter of cost accounting for which the energy balance and the Fanning equation supply basic information. Specifically, these equations determine the power requirement for each pipe size.

Numerous formulas have been proposed, all of which are derived by mathematically expressing the cost in terms of pipe diameter. An analytical relation[2] yielding a solution for optimum pipe diameter is:

$$D_{Opt.} = \left(\frac{1.32w^{2.84}\mu_c^{0.16}YK}{n(a+b)(F_e+1)XE\rho^2}\right)^{(4.84+n)} \qquad (23)$$

Friction factor does not appear as such in Eq. (23) but was used in its derivation. For this case, the friction factor $f = 0.04/(N_{Re})^{0.16}$ as suggested by Eq. (21).

a = Fraction of investment charged per year for amortization.
b = Fraction of investment charged per year for maintenance.
$D_{Opt.}$ = Optimum pipe diameter, in.
E = Over-all mechanical efficiency of pump and motor.
F = Allowance for fittings and installation, expressed as fraction of the cost of the pipe.
K = Cost of electrical energy for pumping, $/kwh.
n = Exponent in pipe cost correlation. Investment = XD^n For steel pipe $n = 1.5$.
X = Cost of 1-in. pipe, $/ft.
Y = System operation, hr./yr.

By assuming average values for these terms, we get an approximate equation which is:

$$D_{Opt.} = 4.0w^{0.45}/\rho^{0.31} \qquad (24)$$

These equations are unlikely to give a diameter corresponding exactly to the discrete pipe sizes available. Hence, we use the nearest standard pipe size. In view of the limitation on available pipe sizes and the approximations made in deriving these equations, we should consider the equations as approximations only. Primary value of these equations is as a starting point for making detailed cost determinations. Final selection should be made by comparing total cost of different sizes. In general, the selected size will give a velocity of the magnitude shown in Table II.

REFERENCES

1. "Technical Paper No. 410," Crane Co., Chicago (1957).
2. Perry, J. H., "Chemical Engineers' Handbook," McGraw-Hill Book Co., New York (1950).
3. McCabe, W. L. and J. C. Smith, "Unit Operations of Chemical Engineering," McGraw-Hill Book Co., New York (1956).

Coming:

In the next two articles of this series, we'll discuss flow of compressible fluids and show how to handle flow in noncircular conduits and piping networks. We'll complete our discussion of fluid flow with a final article on multiphase flow and non-Newtonian flow.

How to Estimate Engineering Properties, Part VI

How to Predict Critical Pressure, p_c

In this second article on estimation methods for critical properties, your author covers pressure and volume. Also included is a valuable data table for inorganics.

WALLACE R. GAMBILL, Union Carbide Nuclear Co., Oak Ridge, Tenn.

In our discussion of methods for predicting the critical properties, we have already discussed critical temperature, T_c. In this article we'll continue with critical pressure, p_c, critical volume, V_c, and special methods.

However, before continuing, we want to re-emphasize something that was said earlier in this series. The best way to obtain a physical property is to find a reliable experimental value that has been published previously.

For the critical constants, the best published data sources are those of Kobe & Lynn[21] and of Michael & Thodos.[7] These lists concentrate on data for organic compounds; values for inorganics are apparently not so often encountered in the literature. Therefore, we have prepared a tabulation (*see next page*) of critical constants for inorganics, based on many sources of data.

The best methods for estimating critical pressure are those proposed by Eduljee[4] and by Lydersen.[3] Eduljee's approach uses this equation:

$$p_c = 10^4 M/(\Sigma\Delta_p)^2 \qquad (16)$$

where p_c is in atm. absolute. To sum up the Δ_p terms, use the atomic, bond and group contribution values given in Table VI.

Accuracy of the Eduljee method has already been shown in the comparison given by Table III (*Chem. Eng.*, June 15, 1959, p. 183). Average error for 182 compounds is 3.7%.

Lydersen's method[3] uses this equation:

$$p_c = M/(0.34 + \Sigma\Delta_p)^2 \qquad (17)$$

Nomenclature

a, A, b	Constants.
L_v	Molar latent heat of vaporization, kcal./gram-mole.
M	Molecular weight.
n	Number of carbon atoms per molecule.
p	Absolute pressure, atm.
[P]	Parachor (values of Mumford and Phillips).
$[R_D]$	Molar refraction.
T	Absolute temperature, deg. K.
V	Molar volume, cc./gram-mole.
w	Weight fraction.
x	Mole fraction.
z	Compressibility factor.
$\Delta_T, \Delta_p, \Delta_V$	Incremental constants for equations used to calculate T_c, p_c and V_c, respectively.

Subscripts

b	At the normal boiling point.
c	At the critical point.
cm	Critical property of a mixture.
i	i-th component in a mixture.
pc	Pseudocritical.

with p_c in atm. absolute. For Eq. (17) the incremental constants are summed up by using the values given in Table I (*Chem. Eng.*, June 15, 1959, p. 182). The arithmetic average deviation cited by Lydersen is 3.8% for 172 compounds. The "95% reliability," or the maximum deviation to be expected 95% of the time, is 11.5%.

Riedel[20] used Eq. (17), with a value of 0.33 for the constant, and a different set of atomic and structural increments. His method appears to be slightly less accurate than the two given above, with an arithmetic avg. deviation and "95% reliability" of 4.6% and 13.3%, respectively, for 172 compounds.[3]

For 67 compounds, a recent evaluation[24] showed an avg. error of 4.5% for both Riedel's and Lydersen's methods.

Some Simpler Expressions

Meissner[12] proposed that p_c be estimated from this equation if $T_b > 250$ K.:

$$p_c = \frac{60.3T_c}{(1.5[P] + 9 - 4.34[R_D])^{1.226}} \qquad (18)$$

where p_c = atm. absolute; and T_c is in deg. K. Parachor and molar refraction may be estimated by summation of the incremental constants given in Ref. 10.

Though it applies to both polar

—— p_c • • •

Critical Constants for Elements and Inorganics—Table V

	Chemical Formula	T_c, Deg. K.	p_c, Atm. Abs.	V_c, Cu. Ft./Lb.
Air	.....	132.53	37.17	0.0682
Ammonia	NH_3	405.6	111.8	0.0681
Argon	A	151.12	48.0	0.0302
Arsenic	As	1,076	342	.....
Boron tribromide	BBr_3	573	.....	0.0179
Boron trichloride	BCl_3	452.0	38.2	.....
Boron trifluoride	BF_3	260.9	49.2	.....
Bromine	Br_2	584	102	0.0136
Carbon dioxide	CO_2	304.2	72.95	0.0343
Carbon disulfide	CS_2	549	77.0	0.0366
Carbon monoxide	CO	132.98	34.53	0.0532
Carbon oxysulfide	COS	378	61.0	.....
Carbon tetrachloride	CCl_4	556.31	45.0	0.0288
Chlorine	Cl_2	417.2	76.1	0.028
Chorotrifluorosilane	SiF_3Cl	307.7	34.2	.....
Cyanogen	C_2N_2	399.71	59.0	.....
Deuterium (normal)	D_2	38.43	16.42	.....
Dichlorodifluorosilane	SiF_2Cl_2	369.0	34.5	.....
Fluorine	F_2	118.2	25.0	.....
Germanium tetrachloride	$GeCl_4$	550.1	38.0	.....
Helium[a]	He	5.25	2.261	0.2315
Helium-3 (isotope)	He^3	3.34	1.15	.....
Hydrazine	N_2H_4	653	145	.....
Hydrogen (normal)[a]	H_2	33.19	12.98	0.515
Hydrogen bromide	HBr	363.2	84.44	.....
Hydrogen chloride	HCl	324.7	81.55	0.0385
Hydrogen cyanide	HCN	456.7	53.2	0.082
Hydrogen fluoride	HF	503.4	.....	.....
Hydrogen iodide	HI	423	81	.....
Hydrogen selenide	H_2Se	411	88	.....
Hydrogen sulfide	H_2S	373.6	88.85	0.0459
Iodine	I_2	826.3	.....	.....
Krypton	Kr	209.4	54.24	0.01762
Mercury[b]	Hg	1,173	179.9	0.00356
Neon[a]	Ne	44.39	26.86[c]	0.0332
Niton (see Radon)	Rn	.....	.....	.....
Nitric oxide	NO	180	64	0.0313
Nitrogen	N_2	126.26	33.46	0.0515
Nitrogen dioxide (peroxide)	NO_2	431.2	99.9	0.0286
Nitrogen tetroxide	N_2O_4	431	99	.....
Nitrous oxide	N_2O	309.7	71.7	0.0351
Oxygen	O_2	154.8	49.9	0.0385
Ozone	O_3	268.2	67	0.0299
Phosgene	$COCl_2$	454.9	56	0.0312
Phosphine	PH_3	324.5	64.4	0.0535
Phosphonium chloride	PH_4Cl	322.3	72.8	.....
Phosphorus	P	968	82.2	.....
Radon	Rn	377.6	62.44	.....
Silicon tetrachloride	$SiCl_4$	506	.....	.....
Silicon tetrafluoride	SiF_4	259.1	36.7	.....
Silicon tetrahydride	SiH_4	269.7	47.9	.....
Stannic tetrachloride	$SnCl_4$	591.9	36.95	0.0216
Sulfur	S	1,313	116	.....
Sulfur dioxide	SO_2	430.7	77.8	0.0306
Sulfur hexafluoride	SF_6	318.71	37.11	0.02135
Sulfur trioxide	SO_3	491.5	83.7	0.0253
Trichlorofluorosilane	$SiCl_3F$	438.5	35.3	.....
Uranium hexafluoride	UF_6	503.4	45.5	.....
Water	H_2O	647.31	218.00	0.0504
Xenon	Xe	16.59	57.64	0.01462

NOTES—*a*. It is recommended that the following modified values of critical temperature and pressure be used for hydrogen, helium, and neon in connection with generalized fugacity coefficient or compressibility factor charts: For hellum, 13.25 and 10.26; for hydrogen, 41.19 and 20.98; for neon, 52.42 and 34.90. These modifications were shown to result in better agreement by Newton in Ref. 32.

b. These values for mercury are considered by the author to be the most reliable available. Extreme disagreement exists in the literature concerning the critical properties of this element. The values given here, calculated by the writer, were checked independently and almost exactly by R. R. Dreisbach at the request of N. A. Lange, whom the author had written concerning this point. The values most commonly found in the literature are 1,735 K. for critical temperature and 1,042 atm. abs. for critical pressure.

c. There is some question as to whether the critical pressure of neon is 25.9 or 26.9 atm., although the latter figure appears to be more reliable.

and nonpolar compounds, Eq. (18) gives poor results for the first few members of an homologous series, as do many physical-property estimation methods. When T_c in Eq. (18) is in turn estimated by Eq. (7), the avg. error for 26 compounds is 17%; excluding acetic acid, acetonitrile and methanol, the avg. error decreases to 7.5%.

Meissner & Redding[13] proposed this equation:

$$p_c = 20.8T_c/(V_c - 8.00) \quad (19)$$

where T_c is in deg. K.; V_c = cc./gram-mole; and p_c = atm. abs. For 89 compounds, Herzog[9] found a max. error (for 95% of the cases) of 19.1% for Eq. (19). Slightly better results were obtained by Herzog by fitting the constants of the Wohl equation:[35]

$$p_c = 21.8T_c/V_c \quad (20)$$

by least squares to data for the same 89 compounds. This resulted in:

$$p_c = 21.75T_c/V_c \quad (21)$$

with the units the same as those given above. Maximum error (for 95% of the cases) is 18.1%.

It is important to note that Eqs. (19), (20) and (21) are not very applicable to associated substances.

Other interesting and sometimes useful estimation methods include those of Thodos,[8] which is quite accurate for aliphatic hydrocarbons only; Thomas,[5] Herzog,[9] Pilcher & Ward,[11] and Gamson & Watson.[24]

To Get the Critical Volume

Lydersen's equation[2] for critical volume, V_c, based on an earlier attempt by Schuster,[30] is given in this form:

$$V_c = 40 + \Sigma\Delta_V \quad (22)$$

where V_c is in cc./gram-mole; and where Δ_V is evaluated by summation of the incremental constants given in Table I (*Chem. Eng.*, June 15, 1959, p. 182). For this approach, the avg. deviation and "95% reliability" were 2.4% and 6.7%, respectively, for 140 compounds (all the available data).[3]

Meissner's approach[13] requires evaluation of parachor and molar refraction:

$$V_c = 0.55(1.5[P] + 9 - 4.34[R_D])^{1.155} \quad (23)$$

where V_c is in cc./gram-mole. Eq. (23) appears to be the most accurate of Meissner's three equations. For normal aliphatic hydrocarbons, the max. error was claimed to be less than 5%; but for all chemical classes in general, avg.

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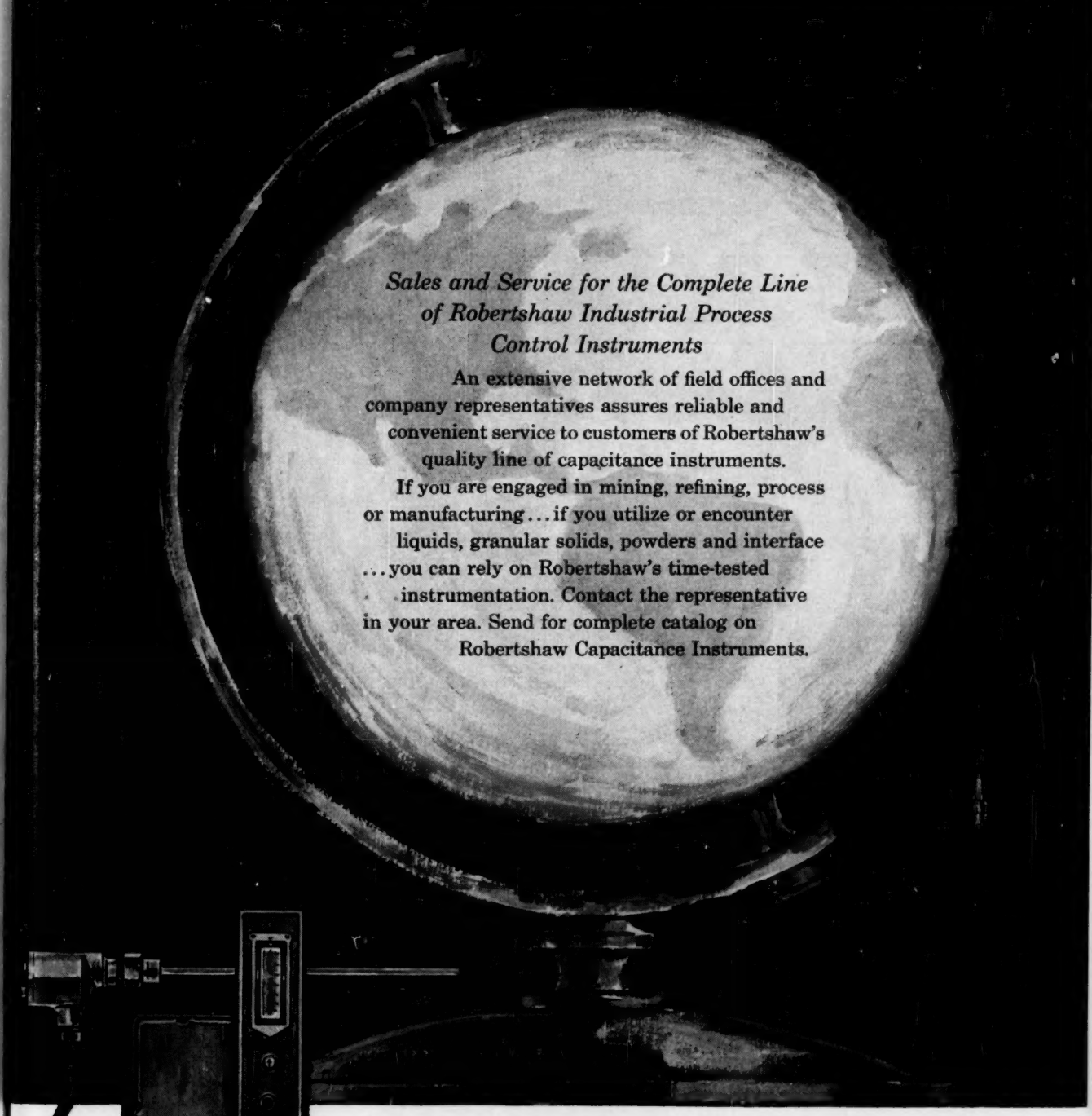

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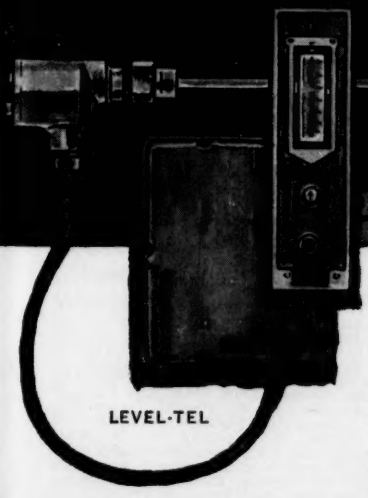

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Structural Contributions for Eduljee's Method—Table VI

	Δ_p	Remarks
Atomic Values		
Carbon	−9.35	
Hydrogen	16.20	
Oxygen	17.20	Etheric oxygen.
Nitrogen	0.0	
Chlorine	48.0	
Bromine	68.8	
Fluorine	39.9	
Sulfur	27.8	
Silicon	22.4	In silanes.
Group Values		
—OH	23.7	In alcohols and phenols.
—C=O	30.2	Ketone group.
—COOH	57.7	Carboxyl group.
—C≡N	52.5	Nitrile group.
Bond Values		
(C)=(C)	28.6 for $n = 2$ 27.9 for $n = 3$ 25.2 for $n = 4$ 21.2 for $n = 5$ 16.4 for $n = 6$ 11.0 for $n = 7$ 5.3 for $n = 8$ 0.0 for $n > 8$	Value depends on number, n of carbon atoms in chain.
(C)≡(C)	51.1	As in acetylenes.
(N)—(H)	−3.15	As in amines.
Ring Structure Values		
5-membered ring	10.5	Homo- or heterocyclic saturated ring.
6-membered ring	7.2	
Benzene ring	84.5	
Position Values		
Single branching or substitution on second carbon atom	−1.6	For multiple branching or substitution, use multiple values for Δ_p. The position of the branch is counted from both ends of the chain and the shorter distance taken.
Single branching or substitution on third or higher carbon atom	−4.75	

and max. errors of 3-4% and 10-15%, respectively, may be anticipated.

Benson[19] followed a novel line of attack and recommended particularly simple relations that are satisfactory for calculating V_c:

$$V_c/V_b = 2.68 \quad (24)$$

$$V_c/V_b = 0.422 \log p_c + 1.981 \quad (25)$$

where p_c is in atm. abs. Eq. (24) holds for almost all "normal" liquids within ±3%. Eq. (25) includes correlation of the deviations from Eq. (24) and also holds within ±3%, for associated as well as regular liquids.

Herzog[8] compared a substantial number of correlation equations for V_c, including his modification of the Meissner & Redding proposal.[13] His final recommendation was:

$$V_c = 2.92[P]^{1.2}/T_c^{0.3} \quad (26)$$

where V_c is in cc./gram-mole; and where the constant is 3.34 for compounds with −C=O, −C≡N, −COOH or −OH functional groups, plus 1 to 3 additional nonfunctional carbon atoms. The max. deviation (95% of the time) for Eq. (26) was 6.5%, and 10% with the other constant.

Herzog also found[8] that the simple equations:

$$V_c = 1.447[P] - 20.09 \quad (27)$$

$$V_c = (0.3591[P] + 14.00)^{1.25} \quad (28)$$

are fairly satisfactory, with respective "95% reliabilities" of 18.1% and 15.7%.

For further discussion of other methods, see Refs. 8, 11, 20 and 37.

Critical thermal conductivity, k_c, and critical viscosity, μ_c, have already been covered in this series.[28] The compressibility factor at the critical point, z_c, has come into recent favor as a "third variable" in more accurate generalized correlations of a number of physical properties. It may, in turn, be estimated from:[8]

$$z_c = 1/[3.43 + 0.0067(L_V)_b^2] \quad (29)$$

For 156 compounds, Eq. (29) exhibited an avg. deviation of 3.8%; the largest errors occurring with organic acids and nitriles.

True critical pressures and temperatures of mixtures are not used in generalized property correlations because the results are much better if the pseudocritical properties are used. The true critical constants are of some value in determining the phase of operation of a process, however, and may be estimated from equations given by Edmister and Benedict.[39, 40]

The time-honored linear molar average method of Kay[41] for pseudocritical constants remains the best method in terms of combined accuracy and simplicity:

$$T_{pc} = \Sigma x_i T_{ci} \quad (30)$$

$$p_{pc} = \Sigma x_i p_{ci} \quad (31)$$

Considerably more complicated equations, but slightly more accurate, have been proposed by Joffe.[42]

For natural gas mixtures, Edmister[43] gives:

$$T_{pc} = 190 + 283s \quad (32)$$

$$p_{pc} = 710 - 60s \quad (33)$$

where T_{pc} is °R.; p_{pc} = psia; and where s is gas specific gravity (air = 1.0) and equals $M/29$. These equations apply for $16 < M < 26$ and for $0.55 < s < 0.90$. Runkle[44] also offers a method for natural gas mixtures.

A brief, but lucid, discussion of mixture T_c will be found in Ref. 45. Ref. 46 provides extensive information concerning T_c and p_c of naturally occurring and other complex hydrocarbon mixtures.

REFERENCES

1.-30. See *Chem. Eng.*, June 15, 1959, p. 184.

31. Kobe, K. A., and R. E. Lynn, Jr., *Chem. Revs.*, **52**, 117 (1953).

32. Newton, R. H., *Ind. & Eng. Chem.*, **27**, 302 (1935).

33. Riedel, L., *Z. Elektrochem.*, **53**, 222 (1949).

34. Reid, R. C., and T. K. Sherwood, "The Properties of Gases and Liquids," McGraw-Hill Book Co., Inc., New York (1958).

35. Wohl, A., *Z. physik, Chem.*, **87**, 1 (1914); **99**, 207 (1921).

36. Schuster, F., *Z. Elektrochem.*, **32**, 191 (1926).

37. Lautie, R., *Bull. soc. chim.*, [5] **3**, 1595 (1936).

38. Gambill, W. R., *Chem. Eng.*, April 1957, p. 273; and Sept. 22, 1958, p. 169.

39. Edmister, W. C., "Applications of Thermodynamics to Hydrocarbon Processing," *Pet. Refiner*, Sept. 1949.

40. Benedict, M., 1939; as given in Ref. 39.

41. Kay, W. B., *Ind. & Eng. Chem.*, **28**, 1014 (1936).

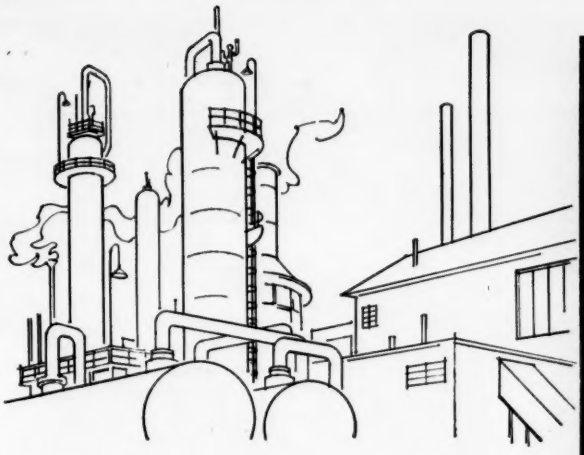
42. Joffe, J., *Ind. & Eng. Chem.*, **39**, 837 (1947).

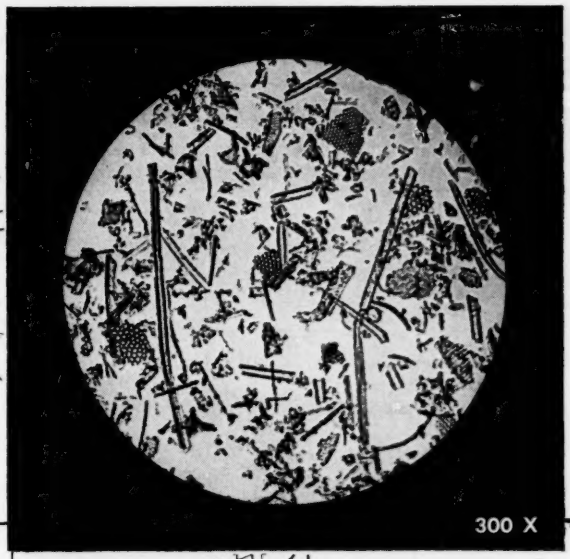
43. Edmister, W. C., "Applications of Thermodynamics to Hydrocarbon Processing, *Pet. Refiner*, April 1948.

44. Dunkle, R. V., *Pacific Coast Gas Assn. Proceedings*, **35**, 80 (1944).

45. Thiele, E. W., and W. B. Kay, "Temperature, Its Measurement and Control in Science and Industry," American Institute of Physics, Reinhold Publishing Co., New York, 2nd Printing (1947).

46. Organick, E. I., *Chem. Eng. Progress Symposium Series*, **49**, 81-97 (1953).





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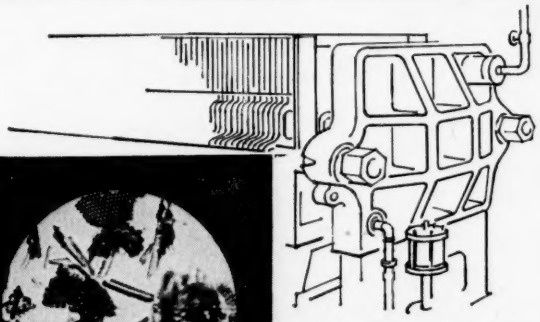

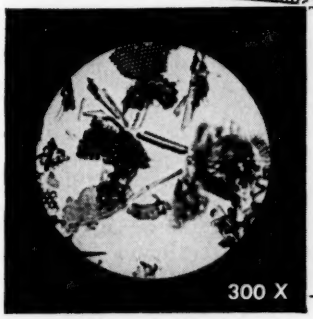

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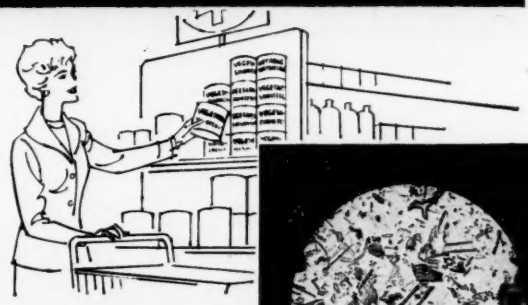

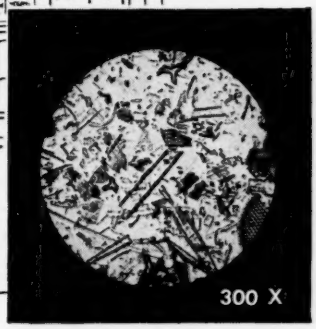

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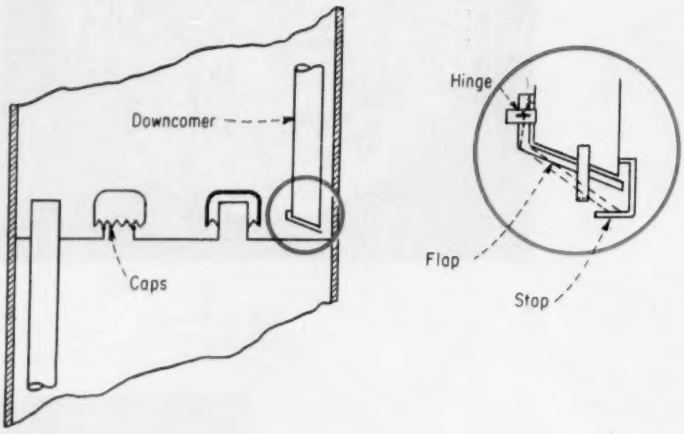

Footvalves for Downcomers Prevent Tower Flooding

**Upsets cause trouble in bubble cap columns—
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One-way valves easily avert this difficulty.**

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Chemical Engineer, Taiwan Fertilizer Co., Ltd., Taiwan, China.

Hold-up or flooding can be a troublesome problem in the operation of bubble-cap columns for absorption or distillation. We encountered this difficulty, for example, in nitric acid absorbers.

During any upset in equilibrium conditions, especially during start-up and shut-down, it is easy for an increase in gas or vapor quantity to alter the differential pressure between successive plates and exceed the static head of the liquid flowing down the downcomer pipes. Liquid is easily blown out of the downcomers, which then become a gas passage.

A simple way to avoid this difficulty is to provide the downcomer pipes with an easily fabricated "footvalve." Any tendency toward flow reversal will close the valve and prevent trouble.

The function of this valve is primarily to increase the resistance toward back-flow, rather than to prevent it entirely, so that it does not need to be fabricated very accurately. Any plant shop can easily turn it out.

Cut off the lower ends of the downcomers at about 15°. Provide for each a flap of any suitable thin material, held by a single hinge and guided at bottom and sides by three strips of metal to prevent opening too wide.

Carbon Dioxide Tracer Measures Air Flow

D. C. Williams
United Carbon Co.
Aransas Pass, Tex.

In one of our plants we had a trouble-shooting job in which it was desirable to know the exact volume of air flowing in the various branches of a complex pneumatic conveying system handling finely divided carbon black. Pitot tube surveys were generally unsatisfactory due to plugging of the pitot tube openings.

We decided to use CO_2 as a tracer. However, we knew that a little CO_2 was already entering the system in process gas leaking in through the rotary air locks. To compensate, we took gas samples at various points in the conveying system, using glass wool filters to trap the carbon black. These samples were analyzed on a precision Burrell gas analyzer.

To make the tests we injected CO_2 into the open end of each branch of the conveyor requiring measurement. To do this we set a cylinder of liquid CO_2 on a platform scale in front of the pipe opening and throttled gas in through a regulator and rubber hose. After conditions had stabilized we timed the flow of 10 to 20 lb. of gas into the system, at the same time taking samples at the desired points.

After the samples had been analyzed for CO_2 it was a simple matter to figure the air flowing in various parts of the system on the basis of the flow rate and specific volume of CO_2.

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Blaw-Knox Equipment Division
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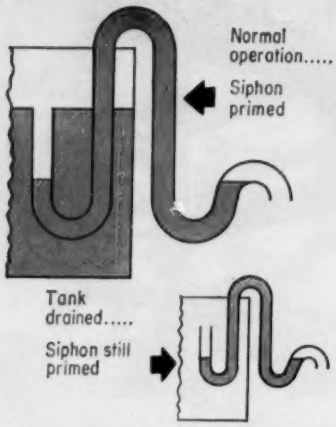


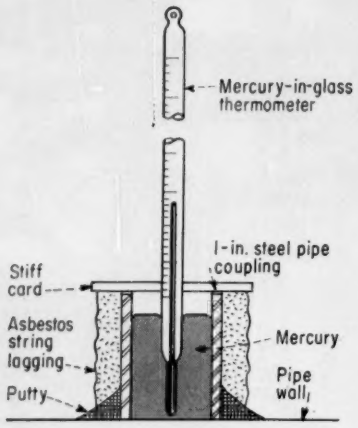
Double Seals Make Siphon Self Priming

L. D. Bryce
Process Engineering Laboratory
General Electric Co., Rome, Ga.

The two designs for self-priming siphons offered by C. F. A. Roberts (*Chem. Eng.*, Oct. 6, 1958 and Dec. 29, 1958) prompt me to submit still another type, shown above, which has the advantage that it will not lose its prime even if the tank is completely drained.

A glass laboratory model can be lifted out of the beaker and carried to another or even left out of water all day, without losing prime.

As the sketch shows, the idea is simply to have a liquid seal at both ends. The height of the inner leg controls the depth to which the tank level will drain at cut-off.

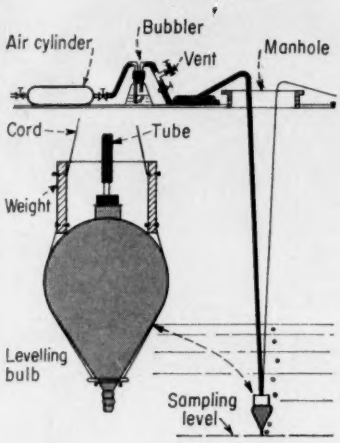


"Stick-on" Thermometer Finds Pipe Wall Temperature

G. L. Head
African Explosives & Chemical Industries Ltd.
Northrand, Transvaal, S. Africa

Sometimes we need to measure temperature in a pipeline where there is no thermowell. Then it is sometimes possible to measure the surface temperature of the pipe and, if the temporary well is sufficiently insulated, get a result which closely approximates fluid temperature.

The sketch shows how this idea is applied to a horizontal pipe. For use on a vertical pipe, substitute a 1-in. steel elbow for the 1-in. steel coupling shown. I have found the method quite accurate even on thick-walled high-pressure piping.



Air Pressure Controls Sampling Depth

A. S. Borsanyi
Canadian Industries Ltd.
Millhaven, Ont., Canada.

An easy method of sampling the liquid at different levels in a storage tank is to use the device pictured above.

The sampler consists of a leveling bottle of the type used in Orsat gas analyzers; a length of rubber tubing a bubbler bottle which can be made of laboratory glassware; a source of air or gas pressure—either an air line or a gas cylinder; clamps and glass connections; and cord for supporting the sample bottle and a weight to sink it, all assembled as in the sketch.

In use, the sampler is sunk to the desired depth while maintaining a slight air flow to exclude the liquid. At the proper depth, pressure is cut off and air vented through the tee to fill the bottle. The sample is lifted with the tee vent closed, then discharged by cracking the air supply valve.

Next Issue: Torsion Dynamometers for Pilot Plant

By Henry R. Bungay III, Winner of the June Contest

★ How Readers Can Win

$50 Prize for Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

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The tube bundle illustrated is installed in a kettle type reboiler shell. Ten duplicate units were furnished. Over seven miles of titanium tubing were required for these units, and titanium has been used to line the high pressure tube side including tube sheets, channel, channel cover and floating head cover. Special titanium flow baffles have been installed in the channel and floating cover to prevent drop out of solids from the corrosive slurry.

When your needs involve any of the difficult metals, turn to Struthers Wells for recommendations and quotations.

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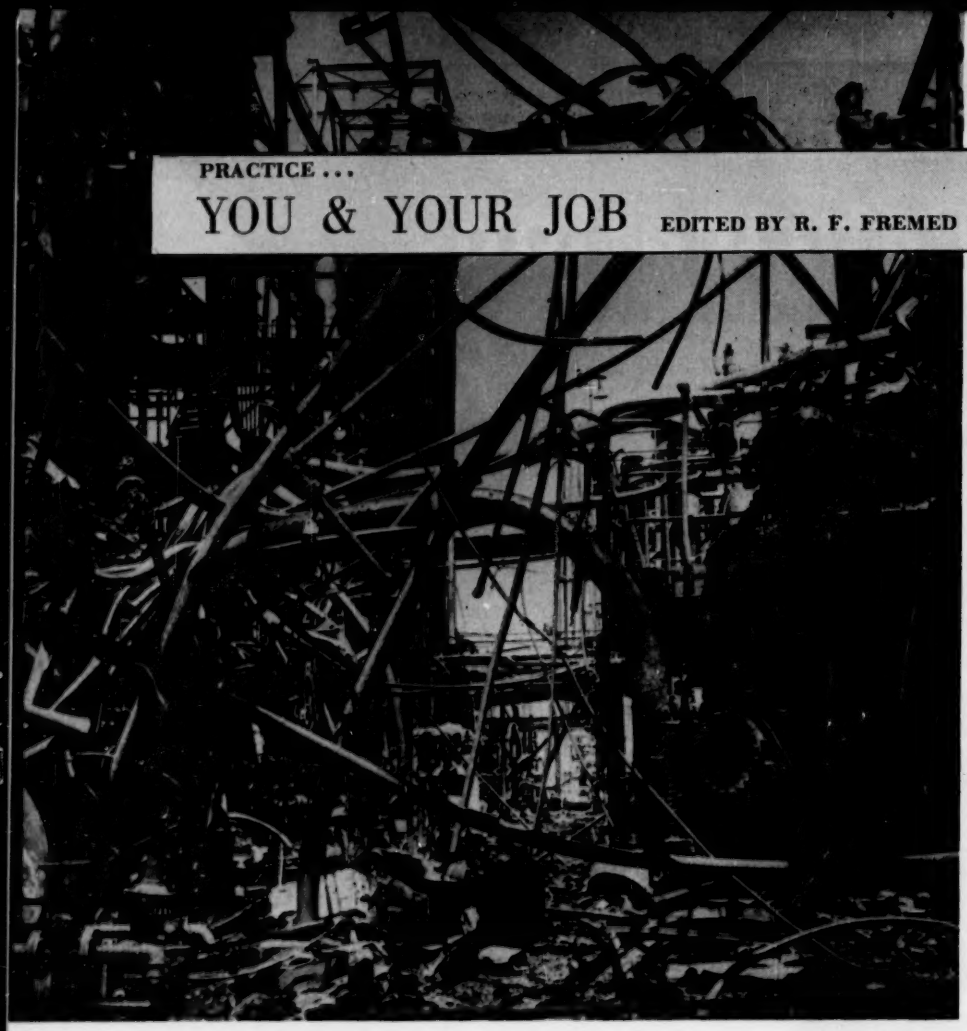

"In order to safeguard life, health and property . . ."

Why Engineering License Laws?

Chemical engineers are getting ready for a new battle over the value of engineering licenses (see box, next page). Here's the story behind the story.

Albert Woodruff Gray, Attorney, Forest Hills, N. Y.

Laws governing the practice of engineering have generally been subject to close scrutiny by the courts of the United States. Traditionally, our jurists have maintained an intense interest in protecting the citizen from discrimination in the enforcement of police power by administrative agencies.

(All engineering registration and licensing laws are extensions of the police powers of the various states.)

Underlying this careful attitude may well be the thought expressed by Lord Acton that, "Power tends to corrupt; absolute power tends to corrupt absolutely."

The editors of *Chemical Engineering* have asked me to dig into the basic principles behind the establishment and enforcement of engineering license laws, and their interpretation by our courts. We think you'll be interested in the results of this research.

The most important conclusion

Progress Report...

New chelates with 2,4-pentanedione

Metal chelates provide a means of deactivating or modifying the properties of a metal ion. Effective chelating agents with many industrial applications can be formed by the reaction of CARBIDE's 2,4-pentanedione (acetylacetone) with numerous metals and oxides.

Pentanedione, or acetyl acetone, usually forms oil-soluble metal derivatives, whereas most other chelates are water-soluble. Certain of these chelates may have possibilities as fungicides, insecticides, driers for paints and varnishes, and colors for inks. Titanium pentanedionate is indicated as an excellent cross-linking agent for cellulose-derivative films and coatings giving them high solvent resistance.

Here are some other ideas . . . By adding a small amount of 2,4-pentanedione to a water solution of a coating-metal salt, hard and bright films can be laid on baser metals without an electric current. The discoloration of cyclic carbonate spinning solutions of acrylonitrile polymers can be inhibited by adding 0.1 to 3.0 per cent 2,4-pentanedione to the solution. Butadiene may be copolymerized with 2,4-pentanedione to produce an improved grade of synthetic rubber, suitable for industrial uses. A granular, water-insoluble, anion-active resin can be made with 2,4-pentanedione as the reactive ketone. The soluble metal derivatives of 2,4-pentanedione should be evaluated for their ability to increase the efficiency of internal combustion engines when added to lubricating oils.

Remember, CARBIDE's 2,4-pentanedione is fully miscible with most organic solvents. Its molecular weight of 100.1 also makes it interesting as an intermediate. For more information a technical bulletin containing many suggestions for applications of CARBIDE's 2,4-pentanedione is available. In it are listed physical properties, specifications and shipping information. For information on other CARBIDE chemicals, write for the 1959 Physical Properties of Synthetic Organic Chemicals—a comprehensive description of the properties and applications of more than 400 CARBIDE chemicals. Please write to Dpt. HE, Union Carbide Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

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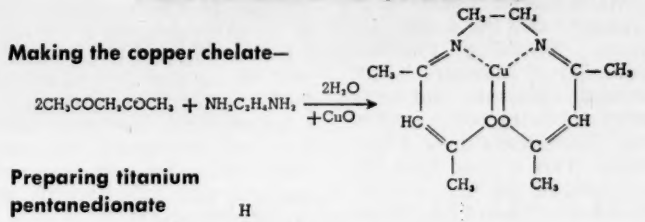
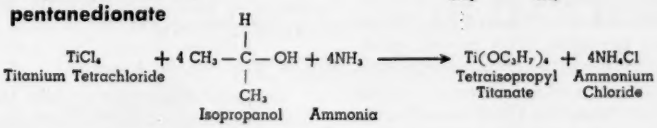
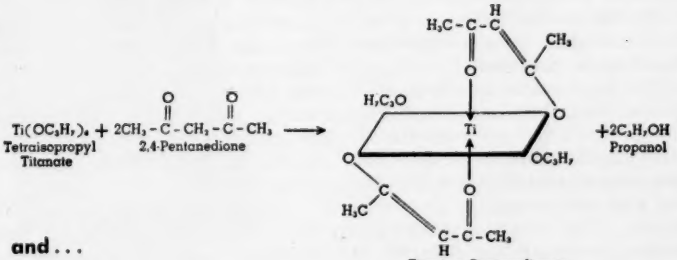
PENTANEDIONE CHELATES

Making the copper chelate—



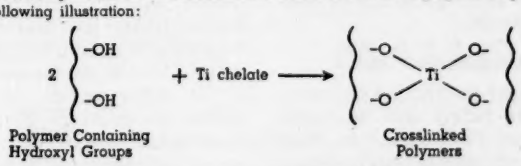
Preparing titanium pentanedionate





and . . .

The crosslinking effects of this material on a cellulose derivative polymer may be shown by the following illustration:



UNION CARBIDE CHEMICALS COMPANY
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"Licensed" Does Not Equal "Professional"

In contradistinction to other groups of engineers, chemical engineers have taken the stand that an engineering license granted by a state government can not, by itself, be equated to a badge of identification as a truly professional engineer.

At its recent meeting in Kansas City, Council of the American Institute of Chemical Engineers has put its official stamp of policy approval on this long-held chemical engineering attitude.

According to AIChE, registration is a personal matter that concerns itself mostly with protection of public safety. Registration should be accorded no more emphasis than is placed on other definite marks of professional standing, such as advanced degrees, active participation in technical societies, or publication.

that I have been able to reach is that "safeguarding of life, health or property" is the only justification—in the eyes of the courts—for the existence of an engineering license law. You can not use such a law to raise revenue; or to prevent an engineer in nonpublic practice from practicing professional engineering; or to avoid paying an engineer for services rendered, when such services do not involve the public safety.

Not to Be Used as a Tax

For example, several years ago in Kentucky the legislature imposed a license tax that was worded this way, "Before engaging in any occupation or selling any article named in this subdivision," followed by a catalog of professional and business activities subject to the tax. Engineering was one of the professions included.

A Kentucky court was then asked to decide whether such a law was subject to judicial review.[3] The court ruled that it had the undisputed right to review taxes imposed upon trades, occupations or professions; and that the courts, when the question is put to them, have the undisputed right to determine whether or not a legislative act is in violation of the Constitution although the purpose of the act is the raising of revenue by taxation.

This distinction between license laws enacted for safeguarding the welfare of the community and those enacted solely for revenue was the determining factor in a case in Pennsylvania. In this case an unlicensed engineer sued for money he claimed was due him for services rendered. However, it's important to note that the engineer was unlicensed and that the services did involve the public safety.

"The act," said the court in its decision, "providing for the registration of engineers is not a revenue measure but was enacted under the police powers of the Commonwealth of Pennsylvania. This is plain from the declaration in the first section, 'In order to safeguard life, health and property, any person practicing or offering to practice the profession of engineering in any of its branches shall hereafter be required to submit evidence that he or she is qualified so to practice and shall be registered as hereinafter provided.'"

The engineer in this case contended that this license law did not prohibit the enforcement of his employment contract for services rendered, even though he was unlicensed in Pennsylvania. The court denied his claim, refusing to enforce a contract which was founded on a violation of a public policy declared by the legislature of the Commonwealth.[3]

Only to Safeguard the Public

This same distinction concerning public safety was featured in a New York case. In this state, professional engineering for which a license is required is defined as follows:

"A person practices professional engineering within the meaning and intent of this statute who holds himself out as able to perform, or who does perform, any professional service such as consultation, investigation, evaluation, planning, design or responsible supervision of construction or operation in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works or projects, wherein the safeguarding of life, health or property is concerned or involved, when such professional service requires the application of engineering principles or data."

Interpreting this law the courts have said, "The difficulty arises in regard to the clause, 'Wherein the safeguarding of life, health or property is concerned or involved.'

"The main contention of the parties herein is whether this clause has reference to buildings, machines or processes mentioned, or to the engineering services. I believe the latter is the real import of the statute. Therefore, professional engineering is practiced whenever the named services are performed, but only when the services concern or are involved with safeguarding life health or property."[3]

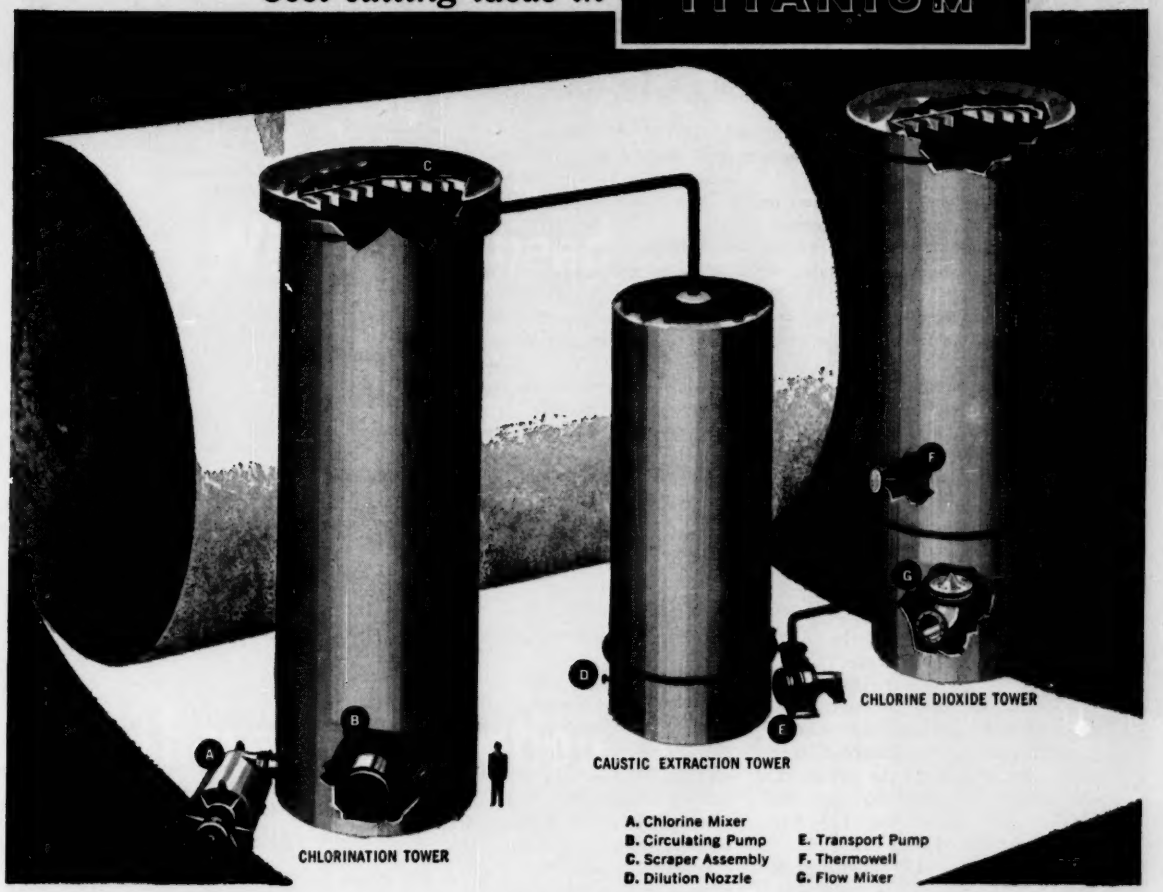
Law Can Not Be Upgraded

This point also arose when the Ohio Society of Professional Engineers sought to prevent by court injunction further activity by a manufacturer of centrifugal casting machines and ship-loading towers who advertised himself as practicing the profession of engineering. (The Ohio law is similar to the New York law cited above.)

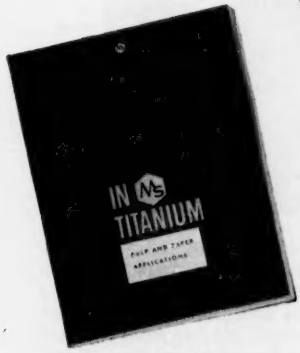
The court set aside a previous injunction granted against this engineer engaged in designing and fabricating these products. "In our opinion the injunctive decree could not by its terms rise higher than the statute from which the court derived its jurisdiction in the first place.

"In other words, it is not within the province of the court to broaden or extend the meaning of professional engineering

Cost cutting ideas in **TITANIUM**



TITANIUM BELONGS IN THIS CORROSIVE PROCESSING PICTURE



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Proposed Principles of Registration

While there are many confusing and controversial aspects about registration, the following principles can be laid down to clear the air:

1. Keep in sharp focus the fact that the only reason for registration is protection of public safety.
2. Discount as subordinate all the self-interest reasons such as promoting professional stature, unification of the profession, and the like.
3. Be sure there is a real (not an assumed or hypothetical) need for added protection of the public before making changes in any direction.
4. Get widespread and thorough discussion and voting on the issues from the entire membership of engineering societies.
5. Don't let aggressive minorities assume they can speak for the whole engineering profession.

B. B. Kuist, *Chem. Eng. Progress*, Aug. 1958, p. 68.

beyond the definition of the term as set forth in the statute."[4]

Here, as in other instances, the court refused to require a license for engineering where public safety is not involved. But when public safety is involved, an unlicensed engineer may be unable to collect his fee for services performed.

In the State of Washington this same feature has been emphasized, that contracts for professional services affecting the well-being of the public are void when the prerequisite to such performance is a statutory license.

"Where a license or certificate is required by statute as a requisite for one practicing a particular profession," said a court of that state in its decision, "an agreement of a professional character without such license or certificate, is ordinarily wholly illegal and void. This is true, for example, of an agreement made by an unlicensed or uncertificated physician, an attorney at law, a conveyancer, an engineer or a school teacher.

"The authorities are in accord on this point, where the license is required for public protection and to prevent improper persons from acting in a particular capacity, and not for revenue purposes only."[5]

Notice how the court distinguishes once again between the taxation and police powers of the state.

Defining the Services

Another case in New York State is quite interesting. A consulting engineer employed in research and development on photographic equipment sued to recover money due him under his employment contract. The employer tried to interpose the professional engineering statute as a defense, explaining that it did not have to comply with the terms of the employment contract since the engineer held no professional engineering license.

"No license, no pay," said the employer.

The court took a long, hard look at the New York State law which provided, in part, "In order to safeguard life, health and property, any person practicing or offering to practice professional engineering in this state shall hereafter be required to . . . be duly licensed under the provisions of this article."

Holding that this statute did not relate to services of a research and development character, the court awarded the engineer the recovery he sought. Said the court, "We are further of the opinion that these sections are not applicable to this employment."

This distinction between the type of engineering services for which a professional engineer forfeits his compensation in the absence of a statutory license and those which do not involve the welfare and good of the public (to which such a forfeiture is not extended) was well stated many years ago by a federal court.

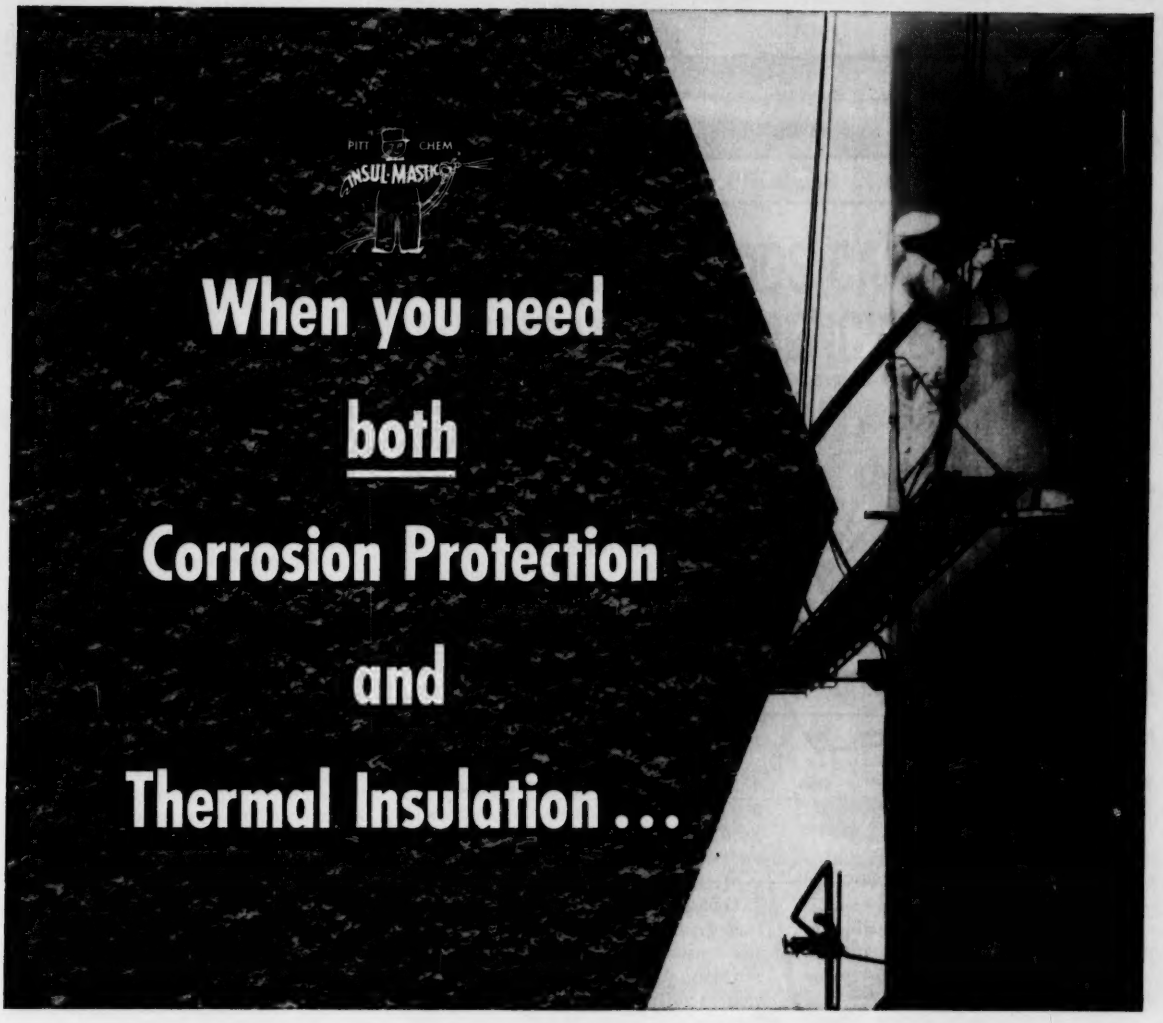
"'The true rule is that the court should carefully consider in each case the terms of the statute which prohibits the act under a penalty, its object, the evil it was enacted to remedy. The court should consider also the effect of holding contracts, made in violation of the statute, void; for the purpose of ascertaining whether or not the law making power intended to make such contracts void; and if, from all considerations, it is manifest that the legislature had no such intentions, the contracts should be sustained and enforced.'"[6]

REFERENCES

1. Hager vs. Walker, *197 S. W. 254, Kentucky*, Jan. 23, 1908.
2. Lindholm vs. Mount, *60 Atl. 2d 422, Pennsylvania*, July 23, 1948.
3. Usdin vs. Kvatinetz, *60 N.Y.S. 2d 634*, Jan. 27, 1947.
4. Ohio Society of Professional Engineers vs. Hulslander, *89 N. E. 2d 119, Ohio*, Sept. 26, 1949.
5. Sherwood vs. Wise, *232 Pac. 309, Washington*, Jan. 9, 1925.
6. Dunlop vs. Mercer, *156 Fed. 545*, Oct. 31, 1907.

ALBERT WOODRUFF GRAY was born in Middletown Springs, Vt., and attended Yale Univ. and New York Law School. He has been engaged in the independent practice of law for more than 20 years. For four years he served as legal watchdog on advertising copy and radio scripts for the Young & Rubicam advertising agency. Gray is the author of Conover-Mast's "Purchase Law Manual," and CE's article "How Our Laws Protect Engineering Ideas" (March 9, 1959).

Free—For your files—Check your Reader Service postcard (p. 217) for an extra copy of this article.



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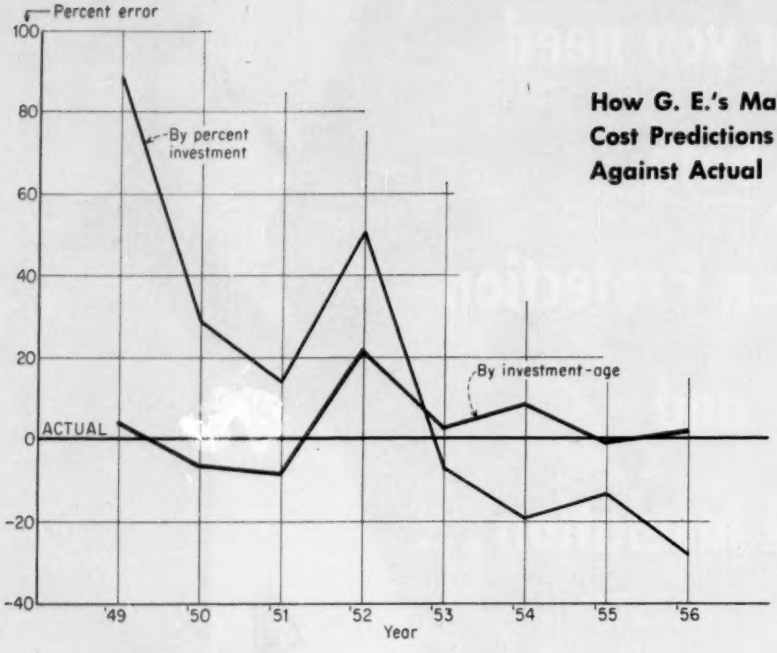


How G. E.'s Maintenance Cost Predictions Stack Up Against Actual

More Light on . . .

Predicting Your Maintenance Costs

Because of your keen interest in maintenance costs and the responses we've had to the first article on this subject, here's more information and data on estimating techniques.

Not too long ago, we published an article on an important but, what you might call, slighted aspect of cost estimation: "Maintenance Cost Estimation . . . Is This a Better Tool for You?" (*Chem. Eng.*, Feb. 9, 1959, p. 140.)

In this piece we presented a new way to predict maintenance charges—by correlating investment and age with the annual maintenance cost.

This provocative topic generated enough replies to make a return engagement profitable. We heard from a number of engineers who are either working with this method (or variations on it) or who struggled with their historical data to see just how good the proposed correlation is.

One point underlies the whole question of maintenace cost estimation: How can you do it with limited data? Well, you can't. This is a problem common to most companies and perennially plagues the maintenance super-

Lubrication News

PROFITABLE IDEAS ON THE LUBRICATION OF CHEMICAL PROCESS EQUIPMENT

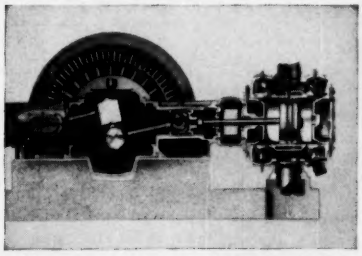
Carbon deposits in compressors are often a result of overlubrication

The plant engineer of a large basic chemicals plant recently handed us this problem: carbon deposits appeared regularly on the valves and cylinders of his air and gas compressors.

A Texaco Lubrication Engineer reviewed the possible causes. First, he checked the lubricants being used; the right lubricant had been specified for each compressor. Next, he examined the mechanical feed system that scheduled the rate of lubrication. Here, he found the feeders were set to admit too much lubricant into the compressors. This was obviously causing the carbon deposits.

He immediately recommended that trials be set up to determine the exact amount of lubricant required in each compressor. Intake valves, discharge valves and cylinder parts were frequently examined for presence of a thin oil film. Where dryness or light rusting appeared, lubricant feed was increased; excessive oil on the parts or in clearance spaces indicated the need for a reduced feed.

A Texaco Lubrication Engineer is always available for consultation on the choice and use of compressor lubricants.



Red arrows pointing to intake valves, discharge valves and cylinder ports show where to look for thin film of lubricant that indicates proper rate of feed. Deposits on valves are usually result of too much oil, poor grade of oil, or dirty intake air.

STORAGE METHODS CAN DETERMINE LUBRICANT EFFICIENCY ON THE JOB

Lubricant performance depends to a large extent on the way the product is stored and handled by the purchaser before it's used. Here are some proven methods that will insure complete protection for stored lubricants.

To avoid contamination with water
Best lubricant storage is in a fireproof building. If lubricants are stored outdoors, however, drums should be placed on their sides, to prevent rainwater from being sucked through the seal by temperature changes. This is particularly important with oils containing additives, since some additives are damaged by water contamination.

Outside storage in cold climate
Low temperature makes lubricants stiff and hard to handle. Heating will restore a workable viscosity, but if too much localized heat is applied to a lubricant it may be rendered useless.

The best way to handle very cold lubricants is to put them indoors and let them reach room temperature slowly. The safest fast heating method is to use exhaust steam. An exposed flame may melt the sealing compounds on the drum and cause leaks.

Safe ways to transfer lubricants
A standard pump that fits the drum opening will prevent contamination in transferring lubricants from one container to another. In some plants the product is applied directly from the original container to the lubricating point. It's essential in any case to avoid using the same pump and hose for different types of lubricants, to prevent contamination.

Ideally the oldest stocks should be used first. All Texaco products are factory-dated to facilitate this procedure. Basic safety demands that the floor of the lubricant dispensing area be kept clean to avoid falls and fires—and fire-fighting equipment should be nearby, just in case.

Guide to Organized Lubrication

This book discusses organized lubrication from management's point of view —as a means of controlling costs. It discusses methods that help raise production, extend parts life, cut downtime. For free copy, use coupon below.

TEXACO INC.
Dept. CE-CP-21
135 East 42nd Street
New York 17, N. Y.

I am attaching my company letterhead to this coupon.

☐ Send a copy of Management Practices that Control Costs via Organized Lubrication.

☐ Send information on Floatcoat.

☐ Ask a Texaco Lubrication Engineer to call at my plant.

Name_____

Title_____

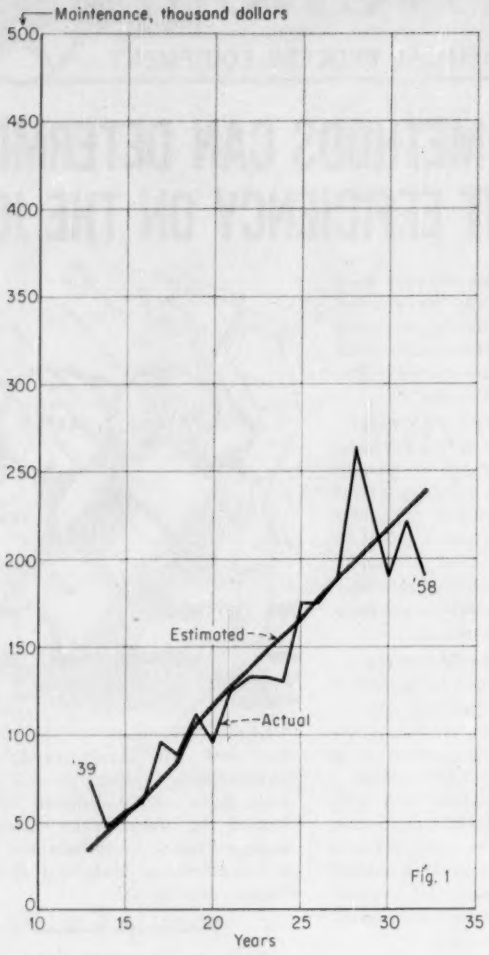
Notice to plants with water-seal gasholders

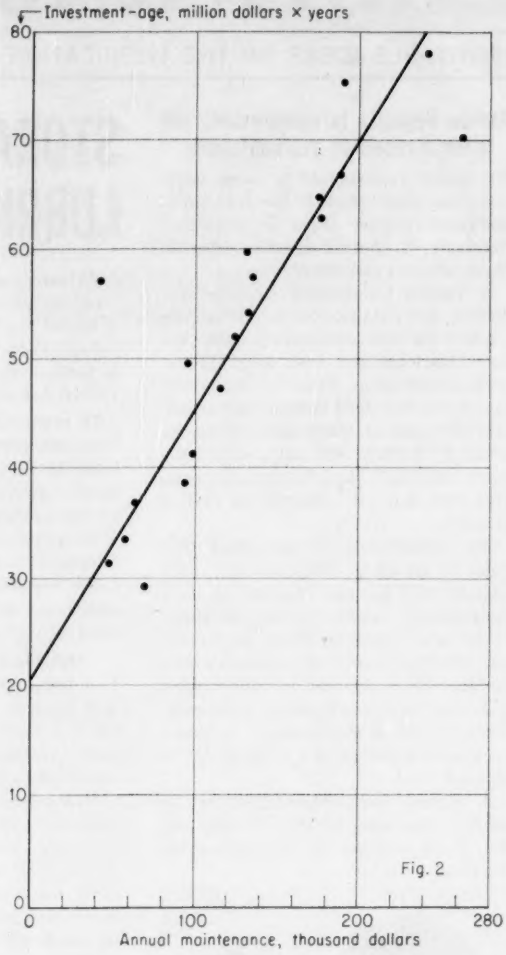
Corrosive effects of water and weather on water-seal gasholders can now be reduced through development of a new use for a Texaco Marine Product. Furthermore, the simple method of applying the product (we call it Floatcoat) sharply reduces maintenance costs by eliminating the need for rigs, scaffolds, and complicated application equipment.

To apply, Floatcoat is merely poured on the water seal. As the tank rises and falls, the coat is spread on the side of the tank automatically. It provides a tough, adhesive shield against both the water in the seal and the weathering effect of the elements. In addition, it penetrates and cleans out existing rust. It is resistant to water washing, needs to be renewed only after long intervals.

Mail coupon at right for more information.

Coke Plant's Estimated Maintenance Stacks Up Well Against Actual Figures





visor examining his operations.

This is a problem that must be cured before you can even attempt to try, let alone use a technique as mentioned here. With good data you can put your finger on many sore spots and keep on top of the job of controlling maintenance costs.

Here then, are two of the more important results we received from people trying the technique. It's important to mention that lack of more complete data places this method in an experimental stage. More data must be supplied and correlated to see just how universal this correlation really is.

This is where you come in. If you have the data to try this technique . . . give it a go and send your results in to us. We can then pass it on.

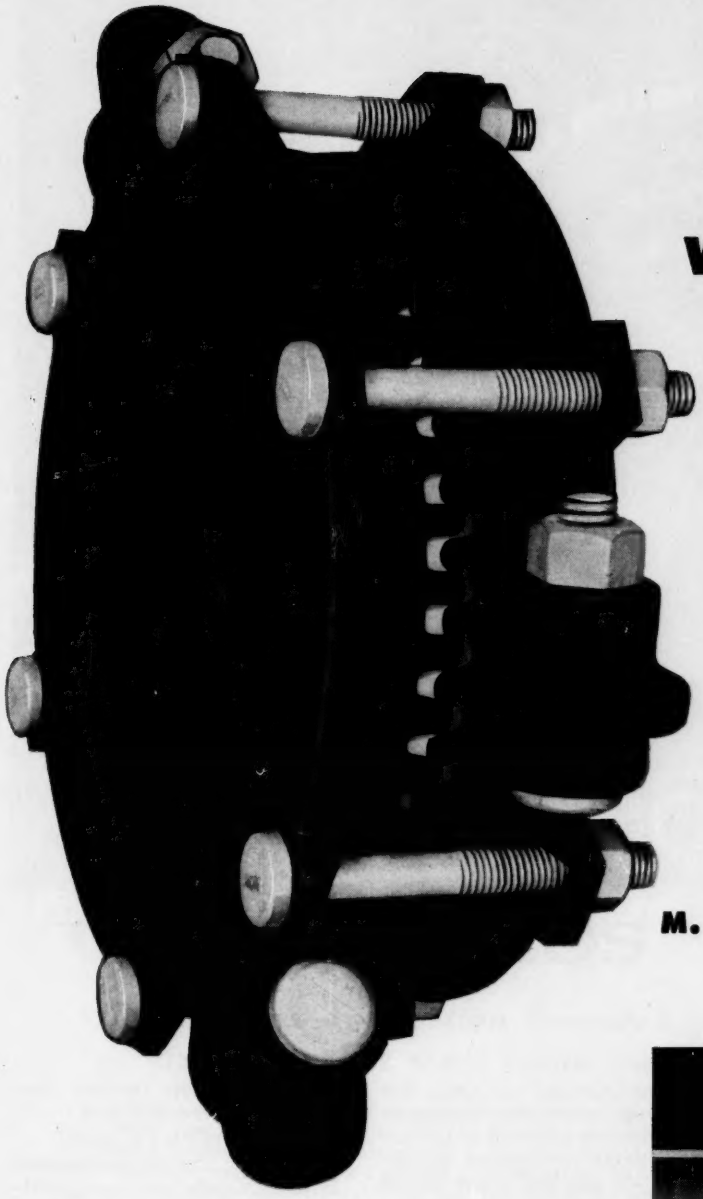
How to Do It

As presented in the earlier article, the original technique is quite simple: Investment times age plotted against annual maintenance gives a straight line. If you have the historical data to construct such a graph you can extrapolate to estimate future maintenance costs.

Investment used in this method is the total value remaining after retirements are deducted. Dollars used were actual. Correcting investment costs to a common base year is an improvement that should be tried. This would eliminate problems resulting from inflation.

To show you how to figure the investment-age quantity, take a look at the following example:

In the first year we invest $100,000 in a new plant. In the second year, equipment costing $30,000 is added. In the third year, the new equipment is replaced with a better design costing $50,000. In the fourth year, capacity is increased requiring an additional investment of $100,000. What are the invest-



FOR STOPPING LEAKS IN WELDED JOINTS

A BIG TIME SAVER—applied quickly and easily under normal distribution pressure. Stops pin hole leaks or splits in welds on welded steel pipe lines.

Triangular-shaped Rubber Gasket is completely SEALED, under tremendous pressure from Intermeshing Compression Rings, by Monel Metal Seal Band and hard vulcanized tips at the edges.

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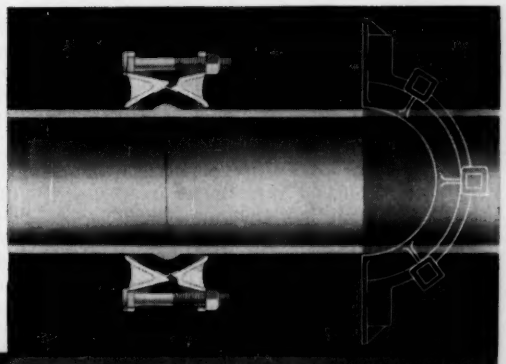
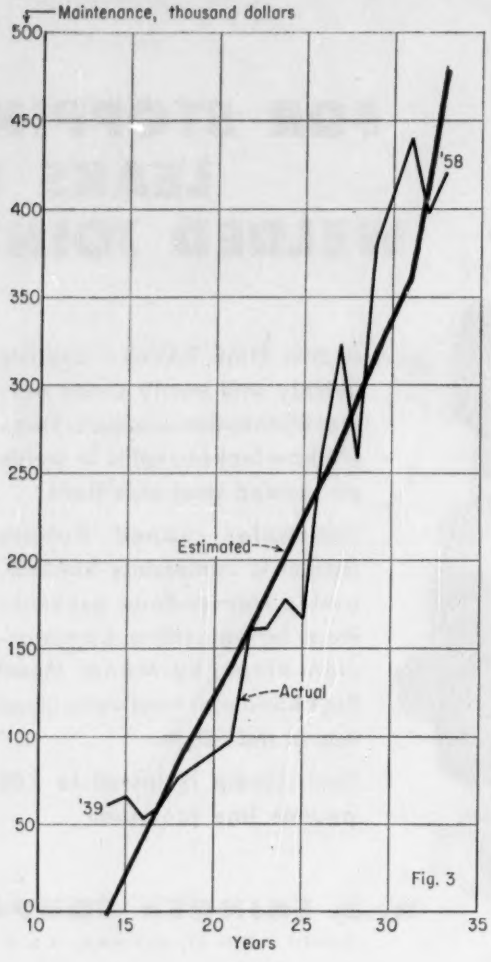
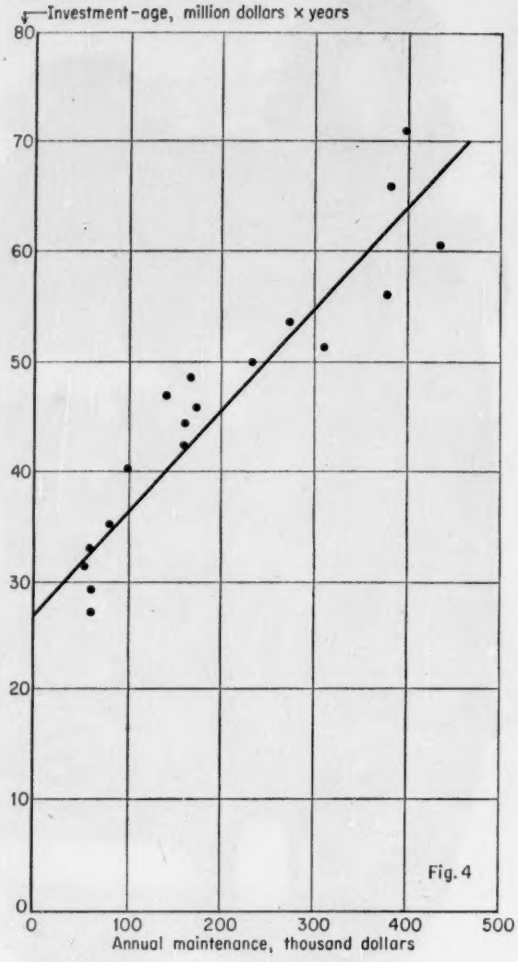


SKINNER-SEAL HIGH PRESSURE WELD CLAMP

Estimated Maintenance Costs for This Cement Plant Are Very Close to Actual





ment-age figures for the first four years of the plant?

At the end of the first year, investment-age is simply 100,000 dollars-years.

At the close of the second year, the $100,000 investment is two years old but the new $30,000 investment only one year. This gives a total investment-age figure of 230,000.

After the third year of operation, the $100,000 has been invested for three years, the $30,000 equipment has been removed and the $50,000 investment replacing it is only one-year old. This brings the third year's investment-age to 350,000.

After running the plant for four years, the initial investment is still intact and four years old, the $50,000 investment is two years old and the new $100,000 capacity increase only one-year old, giving a fourth-year total of 600,000 dollar-years.

Retirements and replacements must be included. If they aren't, the fourth-year figure, relating to a total of $250,000 invested in the four-year old plant, gives an erroneous figure of 1,000,000 dollar-years.

In the original article, the data for investment-age were plotted against annual maintenance for a pulp and paper plant. The straight line that resulted gave a least-squares equation of:

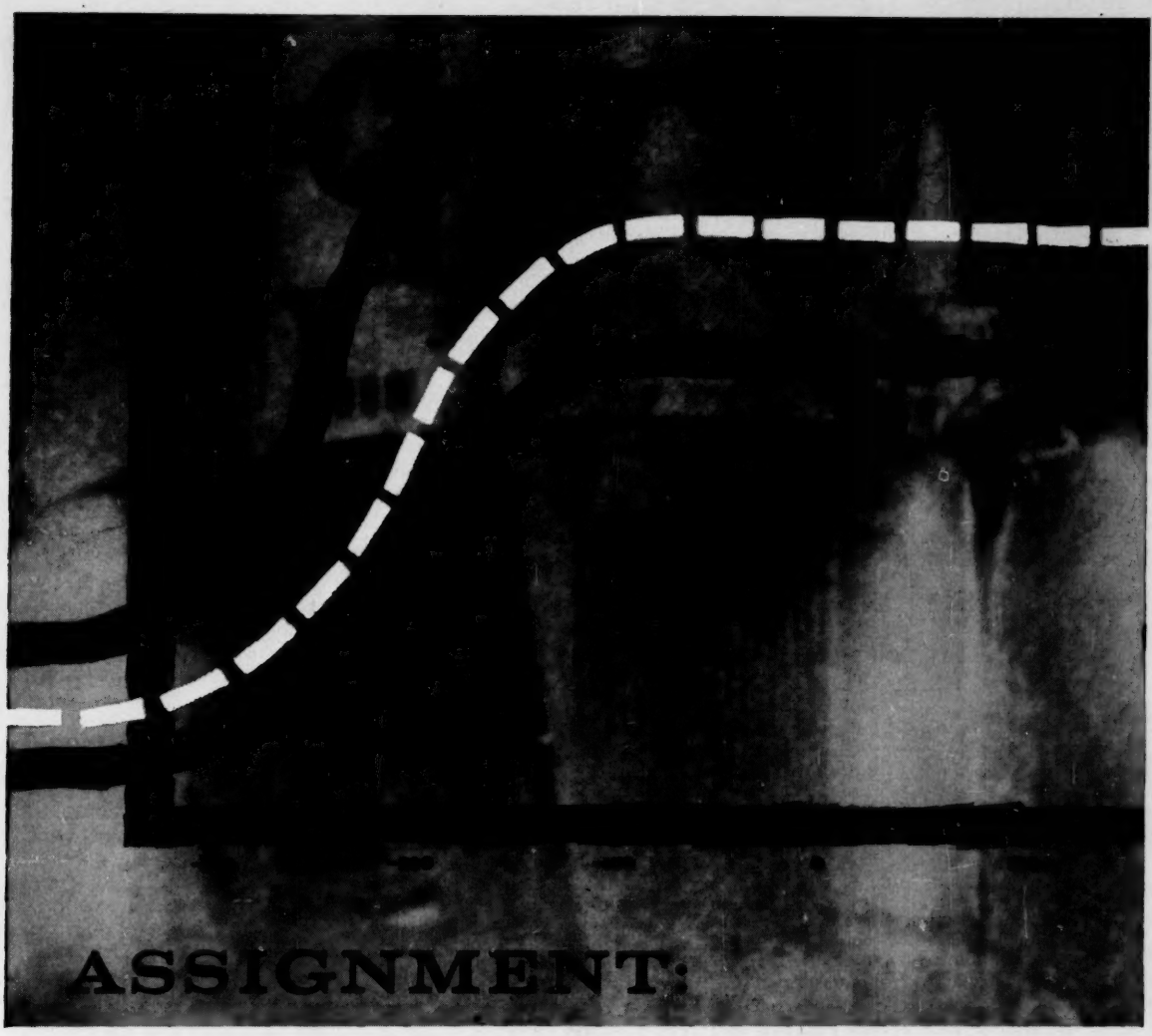
$$M = 0.009\,I \times t + 149{,}000$$

where M = annual maintenance in dollars and $I \times t$ = investment-age in dollar-years. This means, annual maintenance bills in this particular pulp and paper plant are approximately 1% of the investment-age figure.

Of course, this equation might be general for all pulp and paper plants. We don't know as yet. That's why more data are necessary.

Help From the Readers

This technique was tried by J. A. Williams, Manager of In-



CRYOGENICS

How Lukens *Application Research* helps you find the right steel plate for the job

If your assignment is designing equipment for extreme low temperature service—our Application Engineering staff can help you. They research problems of every description from the design stage right through to how the equipment has performed for years after its installation.

Missile components and liquefied gas tanks would be dangerously susceptible to cracking if made from ordinary steel. Seeking economical metals for such applications, Lukens engineers began years ago to watch the performance of nickel bearing alloys in a variety of low temperature equipment. Result: a broad understanding of metal behavior at various low temperature levels.

Examples: In the storage of liquefied oxygen, a tank of *Nine Nickel steel* provided more than eight years of trouble-free performance. Suitable to minus 320°F. service the steel showed no signs of cracking when removed for inspection. In frigid chambers for testing high altitude aircraft, *2½ percent nickel steel* is standing up well under pressures as high as 7,000,000 pounds. And in arctic locomotives operating at temperatures to minus 50°F. on rugged mountain roadbeds, main structures of *Lukens "T-1" Steel* have required no maintenance whatsoever.

Lukens Application Engineers know these cases . . . plus many more. *If your assignment is cryogenics, why not let it be our assignment, too?* Contact Manager, Application Engineering, H79, Services Building, Lukens Steel Company, Coatesville, Pa.

Helping Industry Choose Steels That Fit The Job

LUKENS

ASK FOR LUKENS NINE NICKEL STEEL BULLETIN

dustrial Engineering at Wyandotte's Michigan Alkali Div. and his data are shown in the accompanying illustrations on pp. 174 and 176.

Unfortunately, his investment data represents the gross book value without retirements being deducted. It's entirely possible that his estimates would approach much closer to actual, if retirements were accounted for.

Nevertheless, for the two types of plants shown, coke and cement, maintenance costs seem to correlate fairly well with investment-age.

For the coke plant, the best statistical approximation is given by the equation:

$$M = 0.004\,I \times t - 83{,}091$$

For the cement plant:

$$M = 0.011\,I \times t - 300{,}000$$

Variations on a Theme

Similar to the above-mentioned investment-age correlation, we received from R. Gutoff, G. E.'s Manager of Resins and Fluids Operations at their Silicone Products Dept. in Waterford, N. Y., a variation related and yet different in a significant number of ways.

In a report he was preparing on "Economic Yardsticks for Cost Estimating" he struggled with the gross inadequacies of estimating maintenance as a percent of investment. Gutoff hit on this same idea of correlating maintenance costs against, what he called, investment-age; however, he defined investment-age as follows:

$$\text{Investment-age} = I \times (t/L)$$

where, I is the investment in dollars, t the number of years since the original investment to the present time and L the useful life of the investment.

"This approach," claims Gutoff, "recognizes that not only do investments require a greater expenditure as they grow older, but, equally as important, an investment with a short-expected useful life invariably requires more maintenance than one with a longer-expected life under less severe operating conditions."

He uses as an example: A chemical reactor operating at extreme temperatures and pressures, processing corrosive materials, may have an expected life of only five years. On the other hand, a system making silicone emulsions and processing noncorrosive materials at atmospheric pressure and ambient temperature, may expect a 12-yr. life.

His correlation takes this difference in expected life and accounts for it in the correlation. He claims that this way you don't group apples and oranges as far as investment cost is concerned.

As a guide to projecting useful life, historical depreciation rates were applied to the various elements of plant equipment. In cases where equipment continued to operate beyond originally estimated useful life, the investment-age figure was still used, even though the value of (t/L) became greater than unity.

As an important step, the G. E. people corrected maintenance costs to a common base year using the *Factory Magazine* Maintenance Index and investments using the Marshall and Stevens Equipment Cost Index.

Together with Arthur Dershowitz, process economics engineer, Gutoff worked up the data for the chart shown on p. 172, comparing the error in predicted maintenance vs. actual maintenance costs—using both their investment-age correlation and the more conventional percent of investment.

Clearly, this new technique gives improved accuracy. In addition, they claim, the random errors in the investment-age correlation (both plus and minus) compared with conventional investment estimation, suggests this new approach is less susceptible to drift over a period of years.

For their Silicone Products Dept., Gutoff found the average maintenance cost in the period measured, 1949-1956, ran at about 6.8% of the investment-age. They also found investment-age was a straight-line function of maintenance costs.

As a conclusion, Gutoff says: "We are continuing to examine our maintenance experience against this investment-age correlation, and are convinced that it represents the most useful mathematical tool we have developed for analyzing expenses in this area."

More Data Needed

Send us your results. If you've tried or are working with this correlation or a variation on it, if you are trying it for the first time—we would like to receive the results.

Let us hear from you so we can publish more facts about the method. Send us your data and completed curves.

Photos Cut Costs, Speed Maintenance Work

By using photographs as an integral part of maintenance instructions, Monsanto Chemical Co. is working something of a revolution in efficiency and economy.

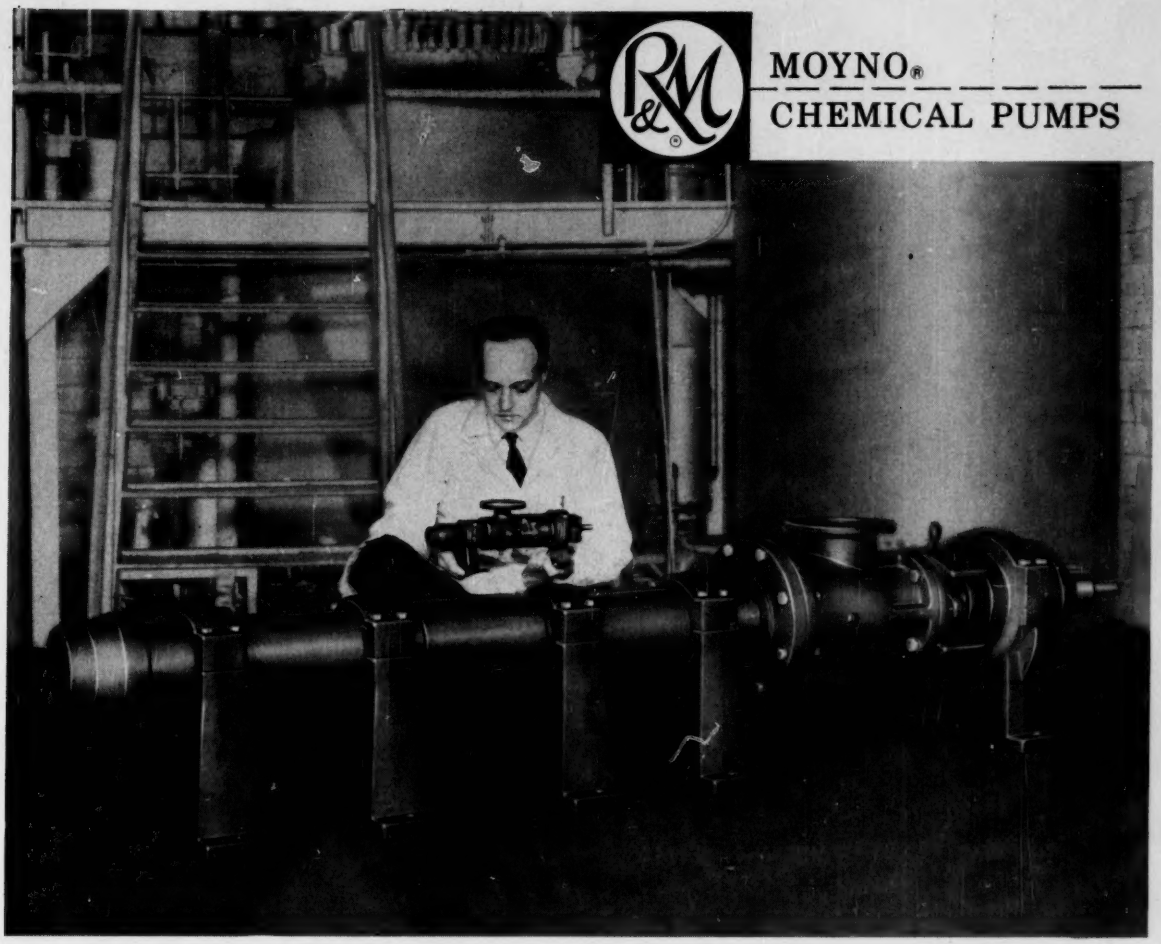
Started at their Plastics Div. in Springfield, Mass., by Clayton Hammond, a maintenance engineer, Monsanto is so delighted with this photographic technique that they're trying the same system out in other plants around the country.

Very simply, written specifications don't always cover all the unguessed situations that arise on a job. Also, words have a way of being misinterpreted, making for long and costly delays.

This system uses a Polaroid Land camera to picture details, parts and places for parts with accompanying text. Photographs are keyed directly into the written instructions by lettering.

With these photographs available before a job is performed, the engineer can study and plan the project with greater efficiency. Written instructions are more readily understood and instantly subject to any corrections necessary before work is started.

To check out the technique, Monsanto ran an interesting test. Two identical jobs were performed by different crews, one using normal written instructions, one using the photographs and keyed instructions. Needless to say, the work crew using the photographs finished the job twice as fast as the other crew.



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CHEMICAL PUMPS

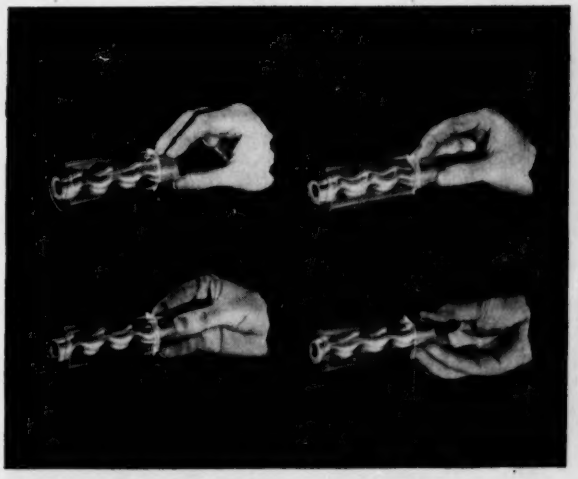
MOYNO® PUMPS

capacities: from 1/100 to 500 gpm
pressures: up to 1000 psi

MOYNO pumps are available in nine sizes with capacities ranging from minimum metering flow to 500 gpm and pressures from zero to 1000 psi. Positive displacement delivers uniform discharge without pulsation, agitation or turbulence. Solutions ranging from thin watery slurry to extremely viscous paste, corrosives, abrasives and even solids in suspension are economically handled without excessive pump wear.

MOYNO's unique *"progressing cavity"* principle with only one moving part and special resistant internal parts slashes pump maintenance costs on problem chemicals that often ruin other pumps. Almost any substance that can be forced through a pipe can be pumped by a MOYNO.

To learn how a MOYNO can cut your pumping costs, see our product information in *Chemical Engineering Catalog*, or write today for Bulletin 30 CE.



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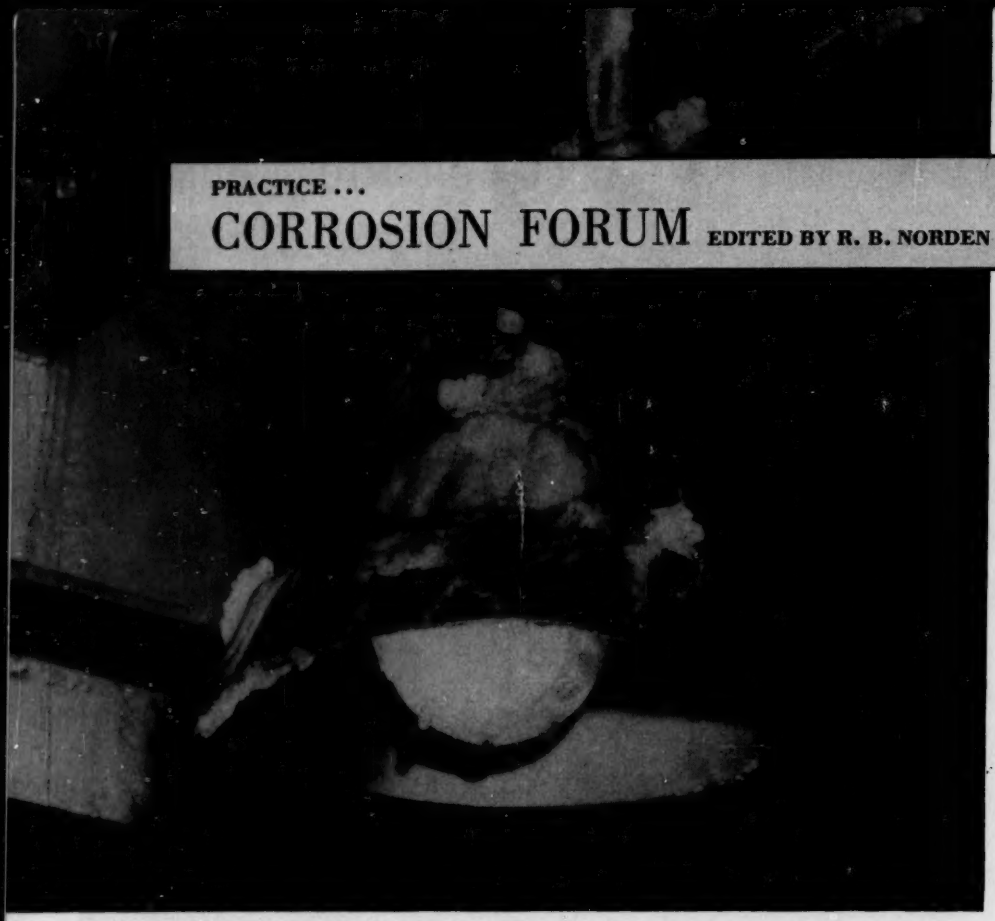
PRACTICE ...

CORROSION FORUM

EDITED BY R. B. NORDEN



ALUMINUM CONDULET and light fixture hold up against ammonium nitrate.

Proper Materials + Correct Design = Corrosion-Free Electrical Installations

R. P. Northup, Crouse-Hinds Co., Syracuse, N. Y.

In chemical plants, corrosion is present to some extent in practically all electrical installations.

Some of this corrosion is of a limited nature and relatively harmless. In other cases a more suitable material or a better appreciation of design factors would have avoided many severe cases which called for costly shutdowns.

A large number of metals and alloys are available for electrical installations, but all have advantages and disadvantages. This information, together with pertinent design factors, are the keys to trouble-free electrical units.

▶ **Ferrous Castings: Low Cost**—As a basic material for cast electrical outlets, enclosures for electrical equipment, and practically all electrical fittings, ferrous-alloy castings offer qualities of high strength, reasonable resistance to corrosion, and availability at low cost.

In general, cast iron shows good resistance to corrosion by alkaline solutions, many organic compounds, and neutral and slightly acid solutions or those having a pH from 4 to 5.

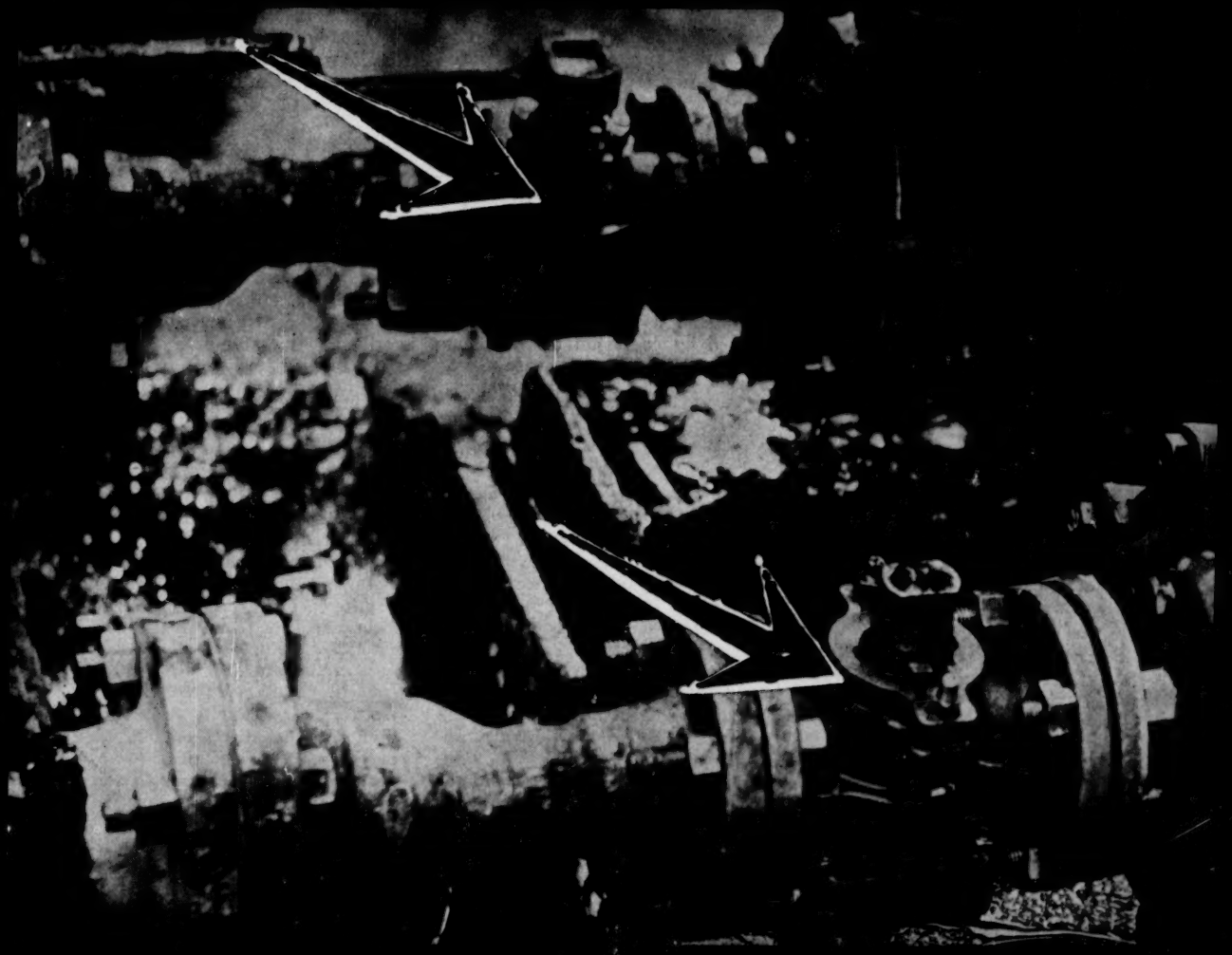
In neutral and slightly acid solutions, corrosion is accelerated by dissolved air or other oxidizing agents, and by elevated temperatures. In some strong acids, cast iron will actually build up a protective coating

---

RUSSELL P. NORTHUP is vice president of engineering, Crouse-Hinds Co. He is an electrical engineer from Syracuse Univ. and is very active in the development of electrical standards and codes. He is a member of the Electrical Manufacturers Assn., API, ASA, AIEE, NFPA.

DURCO TYPE F VALVES have been in service for more than 3 years at KETONA CHEMICAL CORP., Ketona, Alabama, handling 83% ammonium nitrate at 250° F.

These non-sticking, non-lubricated, Durco Type F valves with Teflon sleeves have provided dependable service with almost no maintenance cost. The valves illustrated are of Durimet 20. Durco Type F valves are available from ¼" thru 4" in nine standard corrosion resisting alloys. For complete details, ask for Bulletin V 4b.



Popular Materials for Electrical Installations

Cast iron, mild steel	Good for alkaline environments. Not good for acids.
Stainless steel	Excellent for severe conditions, use for shafts and push-buttons.
Aluminum and alloys	Good for many conditions: salt sprays, sulfur gases. Not good for acid fumes.
Copper, brass, bronze	Good for alkalis, weak acids. Not good for ammonium nitrate or strong acids.
Coatings	Extruded PVC coatings have wide range of resistance (alkalis, acids). Not good for temperatures over 150 F.

of its own corrosion products. However, this does not necessarily mean that cast-iron fittings are preferred for acid environments. Although some acids are more corrosive to iron than others, in general, iron is attacked by almost all common acids of intermediate and dilute concentrations.

Cast-iron or malleable-iron electrical equipment is normally protected by plating with either cadmium, zinc or a combination of both. Zinc is not immune from attack by chemical agents but the products of corrosion are less undesirable than the red rust which disfigures unprotected iron. More important, zinc provides galvanic protection to iron. Zinc coating is consumed at a controlled rate; it is the sacrificial metal in the combination and will protect the underlying iron as long as there is some zinc left on the equipment.

As a further protection, a final top coat of protective paint may be applied. This further arrests attack by many corrosive chemicals.

Iron is reasonably inactive, at least in comparison to some of the more active metals, such as aluminum. Accordingly, it is frequently desirable to combine iron castings with parts made of brass or aluminum. Such assemblies work well except in those areas where the brass or aluminum parts themselves would be severely attacked. Added advantages are obtained by using softer metals in combination with iron castings, especially in mating threaded parts such as screws and covers.

▶ **Important Design Factors**—It is necessary to know degree of exposure when considering materials to use in a corrosive location. A good example is the application of ferrous castings where exposed to hydrochloric acid. Cast iron cannot be recommended where there is direct exposure to liquid hydrochloric acid. However, cast iron has successfully passed the test of long use in areas where chlorine gas, combined with moisture in the atmosphere, causes severe corrosion of such metals as aluminum.

There are few areas where ferrous castings used in electrical systems will be seriously damaged by corrosion to the point where they become unsafe. However, surface corrosion products can form and wherever the condition of the surface is important, means for protection against corrosion should be considered.

Main cause of freezing of operating shafts, which makes parts inoperative and brings about high maintenance cost, is usually buildup of corrosion products. Here, stainless steel shafts and bushings provide excellent protection and reliable operation of electrical units.

▶ **How About Steel?**—Steel is another basic material which appears in a large number of electrical installations—as conduit, as parts of cast iron or malleable iron enclosures, or as complete enclosures.

In general, steel has approximately the same resistance as cast iron to corrosive attack from various chemicals. However, there is one major difference. Cast iron or malleable iron will generally arrest the progress of corrosion by building up a protective surface coating of the oxides. But when steel is attacked, oxidation of the surface tends to be progressive, building up flakes of rust which fall away and permit further rusting below this initial surface. In other words, steel will pit and lose weight, thus losing strength and ultimately eating through under severe corrosive exposure.

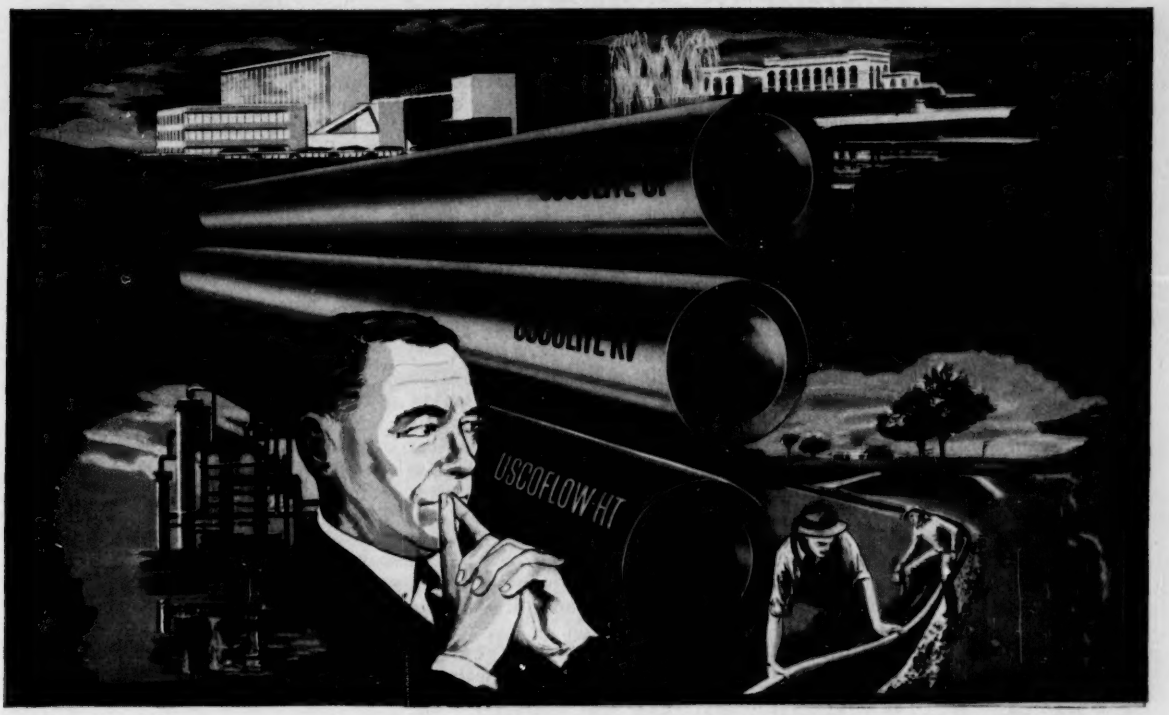
This basic weakness of steel is fully recognized in construction specifications for electrical equipment. The Federal and Underwriters' Laboratories plating specifications for steel parts of enclosures designed for use out-of-doors call for more than three times as much zinc as is required on ferrous castings. Similarly, steel electrical conduit is provided with a heavier protective coating. Steel parts and cast equipment can normally be combined in the same corrosive areas.

Steel requires particular care in protecting raw threads produced when conduit is cut and re-threaded. No installation specification is complete without a requirement that such threads be protected with a corrosion-resistant metallic-base paint, such as lead, or with a thread dope of equal quality. The same requirement does not apply to the threads of enclosures or fittings since these threads are usually internal and fully protected during installation. External threads are plated at the time of manufacture.

▶ **Aluminum Second to Iron**—Tests conducted in the Crouse-Hinds laboratories under the most rigorous conditions indicate that aluminum-alloy castings are second only to protected iron in resistance to corrosion. Hence the popularity of aluminum for cast electrical outlets, enclosures for electrical equipment, and practically all types of electrical fittings which are exposed to corrosive chemical atmospheres.

Although the base metal is more expensive, the fact that aluminum can normally be used without protective coatings tends to offset at least a portion of the

USCOLITE PLASTIC PIPE



CONFUSED ABOUT PLASTIC PIPE?

(MOST EVERYONE IS)

Here's your guide:

U. S. Uscolite® CP acrylonitrile-butadiene-styrene copolymer (ABS-I) pipe is best where maximum resistance to impact is demanded. It will safely handle most chemicals of industrial importance at working temperatures up to 170°F. This is the major plastic pipe used by chemical processing industries.

U. S. Uscolite RV polyvinyl chloride (PVC-I) pipe is best for extremely active oxidizing agents such as strong sulphuric, nitric and chromic acids. This unplasticized, unmodified Type I PVC has high impact strength and handles temperatures up to 140°F, far in excess of normal requirements.

Uscolite HT (ABS-II) pipe is a new addition to the resin-rubber compounds. HT stands for exceptionally High Tensile qualities, plus much better retention of physical properties at High Temperatures.

These types of Uscolite Pipe cover all requirements, not only because they are virtually immune to internal and external corrosion, but they are non-contaminating, odorless, impart no taste or discoloration. Because of these qualities they are approved by the National Sanitation Foundation for carrying drinking water. The use of Uscolite results in a saving of appreciable dollars in installation costs and reduction in man-hours. The skills to install metal pipe are not required to install Uscolite. Assembly can be accomplished in half the time. *Not one foot of Uscolite Pipe has ever failed in service when used in accordance with our recommendations.*

A fourth pipe, *UscoFlow HT (ABS-II)* is a black utility pipe, especially suitable where low first costs are a factor. It's a blend of styrene-base resin and synthetic rubber for good impact resistance and high tensile strength. UscoFlow is the ideal answer to builders and large developers who are seeking long-lived, maintenance-free pipe for plumbing.

We invite detailed inquiries or call your "U. S." plastics distributor. He has the *largest* line of plastic pipe and fittings, plus an experienced background to settle any and all questions about which pipe to use.

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

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cost differential. When exposed to the elements, aluminum is able to protect itself through development of a resistant oxide film. This film forms and repairs itself readily in the atmosphere and in the presence of oxidizing agents.

In general, any of the common aluminum alloys can be used for electrical equipment which is exposed to:

- Ordinary atmospheric conditions.
- Mild salt atmospheric conditions, such as occur in plants near the sea coast.
- Refinery atmospheres, such as locations exposed to oil vapors or sulfur gas.

Because aluminum alloyed with copper has satisfactory strength and is readily machined and worked, copper-aluminum alloy castings are frequently used. Although copper in the alloy is not particularly injurious in most mildly corrosive atmospheres, the galvanic activity between copper and aluminum is very destructive when exposed to heavy salt atmospheres and to such common materials as ammonium nitrate.

Copper-free aluminum-alloy castings are available in a wide variety of enclosures for electrical equipment and electrical fittings. Equipment manufactured of copper-free aluminum has proven very successful in resisting direct salt spray, heavy concentrations of sulfur gases, and the attack of ammonium nitrate produced in fertilizer plants.

Copper-free aluminum alloys can be successfully used for most installations in the food industry because they are resistant to the attack of citric, tannic and acetic acids.

In general, use of aluminum in areas exposed to acid fumes should be avoided. Experience shows aluminum is resistant to corrosion by several concentrated acids, such as nitric, but is attacked by the dilute acids produced by fumes mixed with moisture in the atmosphere. Aluminum should never be used in the presence of chlorine or where it is exposed to hydrochloric acid. Particularly, copper-bearing alloys are seriously attacked in these locations and quickly lose structural strength through progressive deterioration of the structure of the casting.

▶**Avoid Al Troubles**—Because of the active nature of aluminum, extreme care must be exercised in combining other metals with it. Much aluminum equipment on the market today is designed for light weight and little thought is given to the corrosive effect of assemblies made with brass screws or other similar parts.

In corrosive locations, specifications should always call for the use of stainless steel or aluminum screws.

Aluminum is attacked by the binders used in certain gasket materials. Good combinations are neoprene or Buna N gaskets in corrosive locations. Operating shafts, bushings, and other parts should be stainless steel. Little action has been observed between stainless steel and aluminum in the presence of sea water, ammonium nitrate, and hydrogen sulfide.

Threaded parts made of aluminum should always be protected by thread lubricants recommended by the manufacturer. It is extremely important to keep such threads clean and free of abrasive materials.

▶**Brass On the Wane**—Brass and silicon bronze have been long-time favorites as materials for electrical enclosures. Recently, use of these alloys has been sharply curtailed because of their high cost. But they still have a definite place in certain corrosive locations.

As suggested by marine requirements, one of the major properties of brass is resistance to salt water. However, due to high percentages of zinc found in most brass, much better results can be obtained with silicon bronze in similar locations. Both brass and silicon bronze are good for use in the presence of alkalis, except ammonium hydroxide. Silicon bronze also has good resistance to weak acids or sulfur gases. Silicon bronze is effective in some areas where sulfuric acid is handled, such as in oil refining processes involving treatment with dilute sulfuric acid.

Damage to copper parts has primarily occurred in locations where they are exposed to the strong oxidizing chemicals such as nitric and sulfuric acids, chlorine, bromine, iodine, and such materials as ammonium nitrate. Fortunately, copper parts can be protected by plating. In general, best success can be obtained with nickel and nickel-plated parts, although in some instances, it may be necessary to use silver plating. The advantage of nickel is a marked improvement in resistance to heating as well as to corrosion, especially toward alkalis. Nickel is a hard metal which resists the abrasion of parts working together. Silver, except in thick, costly coatings, has limited usefulness in such parts as plug and receptacle contacts because the operation rapidly wears the plating away.

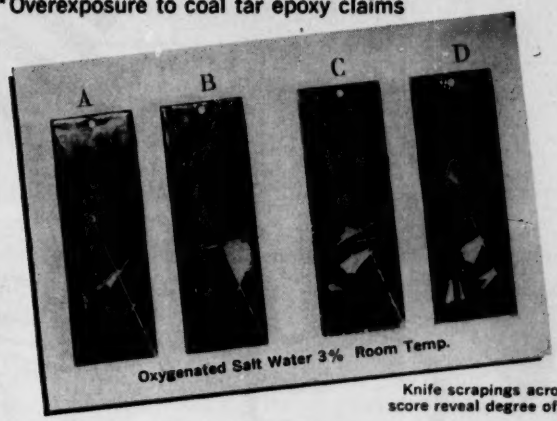
▶**New Development: Plastic Coating**—One of the most interesting recent developments is extruded plastic coating on conduit and similarly coated conduit fittings and enclosures for electrical equipment. Polyvinyls are used for the coating of conduit. The accompanying electrical fittings are coated with polyvinyl chloride. Both materials have satisfactory strength against abrasion and provide resistance to the attack of a wide range of chemicals especially caustics, alkalis and the heavy mineral acids such as hydrochloric or sulfuric.

A major drawback of these materials is they soften at relatively low temperatures. Coated products of this kind should not be used in temperatures exceeding approximately 150F. (a thermoplastic polyvinyl coating will start to flow above 150F.).

In working with such coated products, take care during installation to touch up any sections which become exposed due to cutting threads on conduit, wrenching fittings, or stripping the finish from screw heads in other parts during installation. Touch-up compounds or tapes of the same basic material are supplied for this purpose. With coated products of this kind, a complete plastic-covered metallic installation can be installed without losing the protection of ground continuity or safety of the explosion-proof apparatus through corrosion.

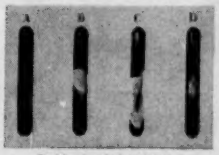
SUFFERING FROM COALTAREPOXICATION?*

*Overexposure to coal tar epoxy claims

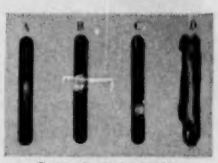


Knife scrapings across diagonal score reveal degree of undercutting.

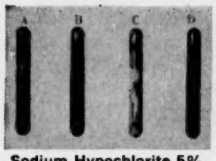
Caustic Soda 5% Room Temp.



Sulfuric Acid 10% Room Temp.



Sulfuric Acid 30% Room Temp.



Sodium Hypochlorite 5% Room Temp.

Aviation Gas 100/130 Octane Room Temp.

Salt Spray (scored panels) Room Temp.

Distilled Water 140°F

Distilled Water Boiling

Sodium Chloride 20% Boiling

Sour Crude 120°F

JP-4 Jet Fuel 120°F

Aromatic petroleum hydrocarbon solvent—120°F

Try these tests to end the confusion

116

So many conflicting claims have been made about virtually every coal tar epoxy coating on the market that prospective users are finding it difficult to fish out the facts from a sea of superlatives.

Perhaps you can find *your* answer by duplicating any or all of these laboratory tests comparing the four leading coal tar epoxies.

THE TESTS: The rods and panels illustrated here were carefully coated to the four manufacturers' specifications and then subjected for three months to the corrosive agents indicated above. The wide range of tests included varying concentrations of chemicals, ambient and elevated temperatures, weathering and all usual types of exposure.

THE RESULTS: Some results were predictable, such as the failure of all four coatings to withstand aromatic petroleum hydrocarbon solvent. But striking differences occurred in such tests as oxygenated salt water, when only Coating A (Amercoat No. 78) resisted undercutting. Products B, C and D were all blistered and undercut to varying degrees. In none of the remaining tests was Amercoat No. 78 excelled, and in most cases it showed marked superiority.

CONFIRMATION: The properties attributed to No. 78 in these tests have been substantiated repeatedly in actual field use. Applicators like it because it (1) gives dependable, all-around protection, (2) sprays more easily than competitive products, (3) builds thick films without difficulty because of its higher solids content, and (4) dries thoroughly but at a moderate rate, avoiding the extremes of prolonged tackiness and fast-dried brittleness.

Because of the unusual importance of these tests to prospective users of coal tar epoxy coatings, we have prepared illustrated copies of the complete report. Write for yours today!

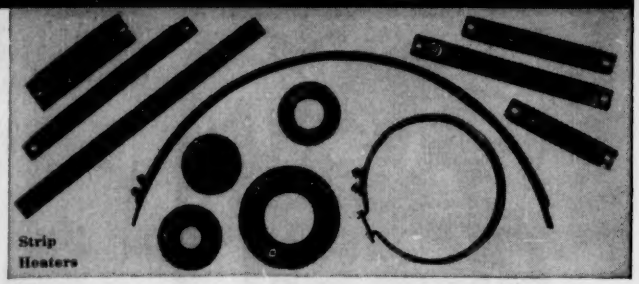
(Amercoat No. 78 was formerly designated No. 1686)

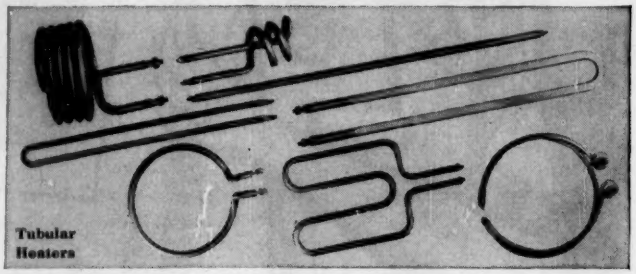
Amercoat CORPORATION

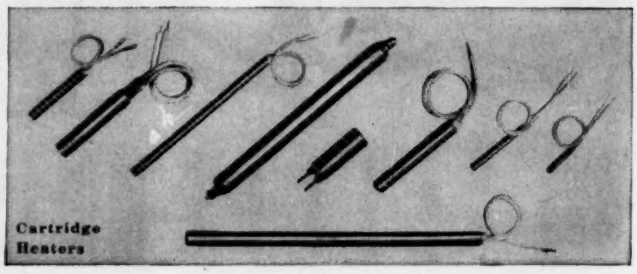
Dept. AG
4809 Firestone Boulevard
South Gate, California

921 Pitner Ave. Evanston, Ill. 360 Carnegie Ave. Kenilworth, N.J 2404 Dennis St. Jacksonville, Fla. 6530 Supply Row Houston, Texas

Call your CHROMALOX Man for the heating answers







These 3 basic CHROMALOX heaters provide answers to just about any heating problem

Strip Heaters . . . that quickly and easily bolt or clamp to platens, dies, kettles, tanks, pipes, rolls, drums, ovens and air ducts. Lengths from 4 to 96 inches, widths from ¾ to 2½ inches, with cross section curving or lengthwise bending. Available with brazed-on fins.

Tubular Heaters . . . that clamp on, fit into machined grooves, cast into metals, immerse in liquids, install in ovens and ducts. Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Available with brazed-on fins.

Cartridge Heaters . . . that smoothly fit standard drilled holes in dies, platens, molds, extrusion and injection barrels. Special leads available for protection against flexing action, abrasion, moisture or vapors. Diameters from ⅜ to 1 19/64 inches, lengths from 1⅝ to 25⅜ inches.

Versatile Chromalox electric heaters are available in sheath materials and wattages to match almost any application to 1100°F. Easy to install, they are fast, clean, safe and economical.

Each has particular advantages. Your Chromalox Man can help you determine the one that best answers your specific problem. He's backed by the world's largest factory stock of industrial heaters, ready for immediate shipment. Why not give him a call. You'll find his phone number listed at the right.

Our new Catalog 60 provides detailed product information and suggests numerous applications for the complete line of Chromalox electric heaters for industry. If you have not yet received a copy, please let us know. 7780

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FIRMS IN THE NEWS

J. A. KING

NEW FACILITIES

July's Top Projects

General Electric Co. announced plans for construction of a 10-million lb./yr., Lexan (polycarbonate resin) plant near Mt. Vernon, Ind. Operation is scheduled to begin by late 1960.

High Energy Fuels, Inc. began operating its 4-million-lb./yr. ammonium perchlorate plant at Columbus, Ohio. Product will be used as an oxidizer material for solid-fuel rockets and missiles.

Air Reduction began construction of a $3-million liquid oxygen, nitrogen and argon plant at Richmond, Calif. New Plant, to be completed by the end of this year, will produce 30 tons/day of liquid product for the missile and metals industries.

Air Reduction has construction under way in Richmond, Calif., on its new air liquefaction unit. Facility will turn out 30 tons/day of liquid oxygen, nitrogen and argon when finished.

Thompson Chemicals Corp. is starting work on a new plant in St. Louis, Mo., to produce a new patented grain control chemical for corn growers. Unit is slated to go into operation October 1.

Ferro Chemical has just completed a $150,000 expansion of its facilities at Bedford, Ohio, for production of vinyl stabilizers and other organic chemicals. Unit is designed to allow company "to diversify into other chemical products."

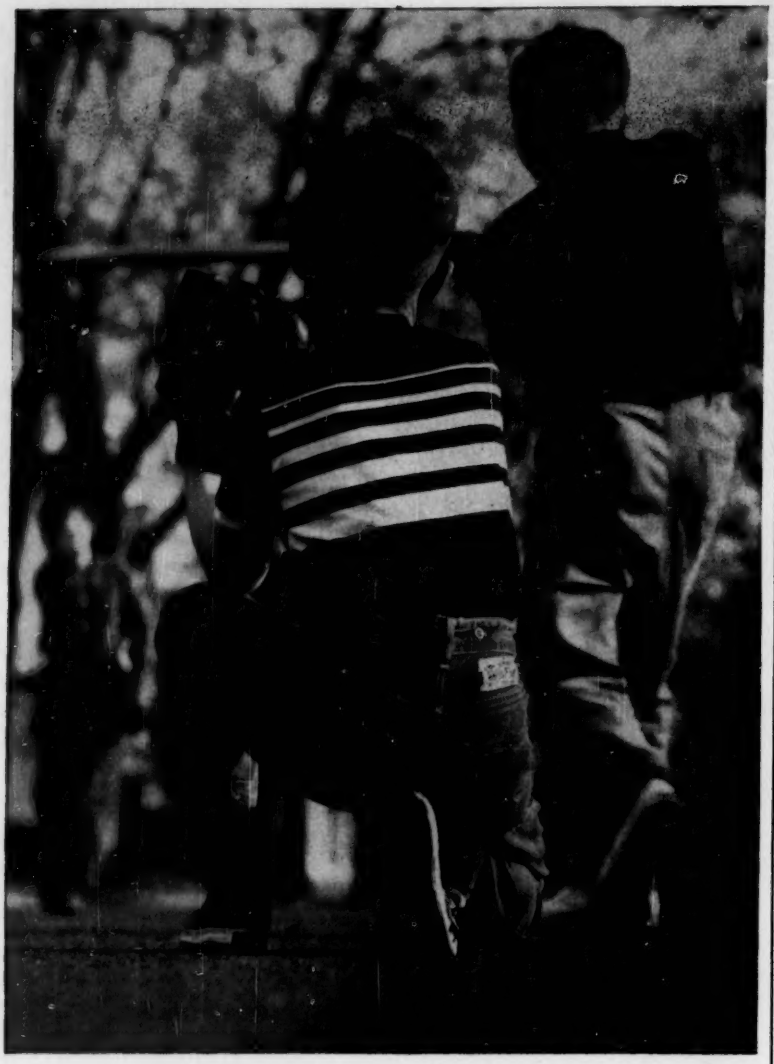
Jacobs Engineering Co., Passadena, Calif., will do the detailed design and engineering on a pilot plant for Southern California Edison to convert sea water to fresh water at a 100,000 gal./day rate to provide power plant feedwater.

Martin Co., Baltimore, Md., has been selected by the AEC to design, develop, construct and test-operate a modular nuclear power plant. Unit, to be built for the Air Force, is one of a family of plants being developed for the Armed Forces in cooperation with the Army Engineers.

Monsanto Mexicana has completed construction of phosphoric acid and sodium tripolyphosphate production facilities of Lecheria, Mexico. New plant is said to have cost several million dollars.

Union Oil Co. of Calif. announces plans for a $17-million expansion to improve gasoline and middle-cut products. Construction, to be completed by fall 1960, will include addition of a 14,000-bbl./day catalytic reformer and three unifiners. Plans also include construction of a $1.5-million CO-fired steam generator.

Badger Manufacturing Co. will design, engineer and construct tall-oil-distillation and



In rubber processing, score more hits with SOLKA-FLOC®

Want to make *better* rubber soles, floor tiles, other rubber products? Then it's time to investigate versatile, economical SOLKA-FLOC.

This finely divided wood cellulose reduces blistering and nerve, controls shrinkage, improves dimensional stability. It permits sharper designs and harder, smoother surfaces. It solves your dispersion problems.

Let us show you how SOLKA-FLOC* adds sales appeal to your products, scores with the customer, increases your profits. Write to us outlining your specific process problems. Address Dept. FD-7, our Boston office.

*Sold in Canada by Brown Forest Products, Ltd., Montreal, Que., (Alpha-Floc).

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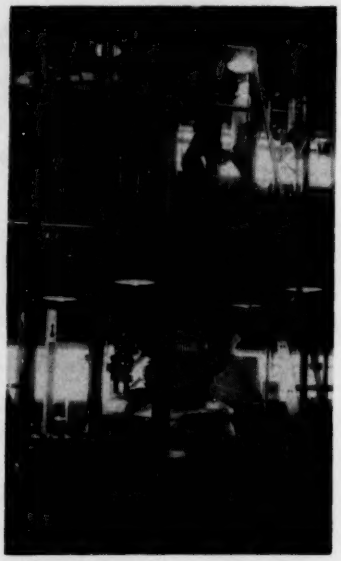
Berlin, New Hampshire

General Sales Office:

150 Causeway Street, Boston 14, Mass.

rosin-treating plants for Arizona Chemical Co. at Springhill, La. Facility to have a throughput of 120 tons/day of crude oil is scheduled to go on stream by mid-1960.



A. E. Staley Mfg. Co., corn and soybean processor, is entering synthetic polymer field. Polymer pilot plant put in operation at Decatur, Ill., early this year is now in semiworks production of acrylic type emulsions. Firm also has negotiations under way to acquire the UBS Chemical Corp. of Cambridge, Mass.

Universal Oil Products will design and construct two Platforming units and three Unifing units for Petroleos Mexicanos. Flour Corp. is acting as engineer consultant to carry out detailed design and procurement.

Reichold Chemicals put on stream a $1-million, polyester resin plant at Houston, Tex.

Dow Chemical Co. announces plans for construction of a $2-million, polyethylene film plant at Fresno, Calif. Construction work is scheduled to begin this summer.

Signal Oil & Gas Co. announces plans to expand its Bankline Refinery at Bakerfield, Calif.,

from 8,000 bbl./day to 15,000 bbl./day. Expansion is scheduled for completion by the end of this year.

Chemstrand Corp. plans to construct a multimillion dollar research laboratory in Durham, N. C. Construction is scheduled to begin late in 1960.

Crown Zellerbach Corp. began operating its new polyethylene-film extrusion plant in Orange, Tex. New facility has a capacity of more than 16-million lb. of free film/yr.

American Industrial Chemical Co. announces added capacity to produce synthetic magnesium silicate. This material is marketed as an adsorbent.

Dow Chemical Co. with Pacific Chemical and Fertilizer Co., of Honolulu have formed Hawiian Extruders, Inc., to manufacture polyethylene film and film products.

International Latex Corp. is now in operation at a new latex laboratory at Dover, Del., to develop new "synthetic latices tailored for hundreds of different industrial applications." Machine above manufactures nonwoven fabrics for the textile laboratory.

The Glidden Co. announces plans for the construction of a $2-million Central Research and Development Laboratory near Cleveland.

Parke, Davis & Co. is constructing a $13-million medical re-

NEW FAIRBANKS-MORSE

Portable Platform Scale

MODERN FUNCTIONAL STYLING

- **reads quickly and clearly under all lighting conditions!**
- **moves easily through narrower aisles!**
- **stays accurate and sensitive under roughest conditions!**

Designed for your most exacting requirements—built for years of heavy-duty use—this new Fairbanks-Morse Model 1124A Portable Platform Scale helps speed your operations through faster, more accurate weighing!

Note the big, clear beam design that promotes quicker reading—the new square weights for easier handling! Check the new concealed wheels, the compact overall width—important for fast handling in congested areas. Notice the absence of check rods, to eliminate binding. From top to bottom this is a handsome, durable scale designed to use—built to last—a worthy successor to the hundreds of thousands of famous Model 1124 Scales proven throughout industry! Capacity 1000 lbs. Write Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois, for new Model 1124A Catalog.

See Sweet's Plant Engineering File for full line of F-M Scales.

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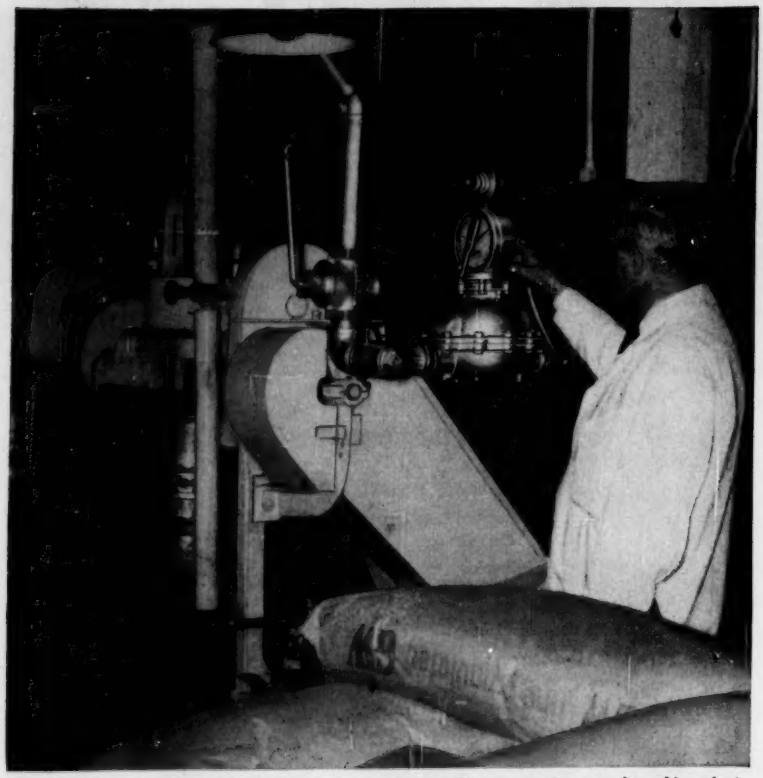
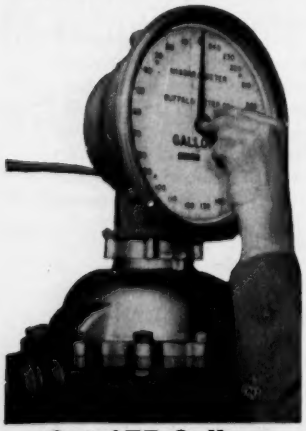
HOW TO INSURE
Uniform Product Quality



Glucose being measured accurately from storage tank to cooking vats in large candy making plant.

Niagara Meters do it Automatically

Set for 175 Gallons



Get 175 Gallons

Consistent high quality in every batch of candy can only be maintained by accurate formulation. That is why this candy company, one of the world's largest, uses Niagara Electricontact Meters to automatically measure the liquid ingredients . . . positive assurance of day by day accuracy that has maintained the enviable reputation and quality of this candy for 15 years.

Whatever your product may be — if measuring of liquids plays a part in its production, you can be sure of consistent quality by the use of Niagara Electricontact Meters. Automatic measurement is a must in today's competitive market. Avail yourself of this cost-saving, time-saving accuracy by automation. Write for complete information.

BUFFALO METER COMPANY, Incorporated

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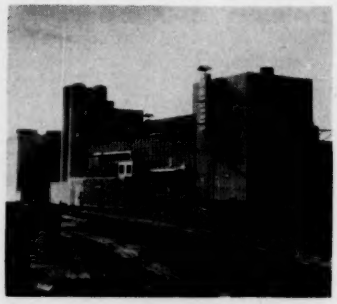
search laboratory at Ann Arbor, Mich. New laboratory is scheduled for completion by early 1960.



American Air Liquide will build a 150-ton/day, oxygen plant for Dominion Foundries and Steel Ltd. at Hamilton, Ontario. New Oxton plant will join other two, built by Air Liquide for Dofosco shown in above picture.

Girdler Process Equipment Co., a div. of Chemetron Corp., will engineer and equip a 60-ton/day edible-oils plant for Western Canadian Seed Processors, Ltd., at Lethbridge, Alberta. Plant is scheduled to begin operating early next year.

OVERSEAS BRIEFS

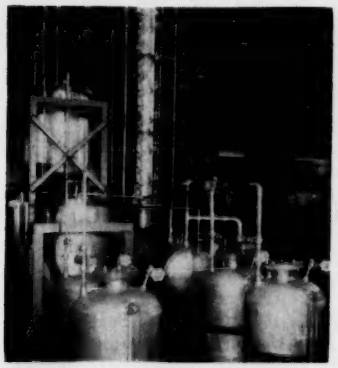
Mitsubishi industries reveal plans to build a $130,000 pilot plan at Akita, Japan, to prove out a new process for phosphoric acid manufacture. New route yields high-quality gypsum as a byproduct. Japanese decline to reveal details of the process.

Vuorikemia, O. Y. began construction of a 16,000-ton/yr. titanium dioxide plant at Maentyluoto, Finland. Most of the output will be exported.

National Carbon Co. of India announces that its $9,450,-

000 polyethylene resin and organic chemicals plant will go on stream in 1960.

Fluor International has been awarded prime contract for construction of a $28-million petrochemical plant to be built at Altona, Australia. New plant will produce raw materials for eventual production of polyethylene, styrene and GRS synthetic rubber.



Badger Mfg. Co. has shipped a packaged experimental laboratory distillation unit to the College of Engineering, Seoul National University, Seoul, Korea. Unit, for instruction and experimental work, can perform batch or continuous distillations.

Courtalds, Ltd., has started producing polypropylene yarns in developmental quantities at the Little Heath, Coventry, plant of British Celanese. Courtalds is in test marketing stage at present, will say only that it is investigating mainly possible industrial uses for the yarn.

Shell International Petroleum is planning to build New Zealand's first refinery. Project will cost about $47.6 million and will have an annual capacity of 2 million tons. Site for the plant and construction schedule have not yet been fixed.

Oronzio de Nora of Milan, Italy, is building the first petroleum-based chemical plant in Cuba, located at Matanzas,

FACTS You Should Know . . . about the DIFFERENCE in Stainless Steel Tubing ——

Both photographs above show the microstructure of the weld and base metal of Type 304 stainless steel tubes. Photograph A reveals accelerated corrosion of the weld metal due to the presence of delta-ferrite. This tube was manufactured by welding, swaging and annealing, which is an insufficient amount of cold work to produce a high quality, uniformly corrosion-resistant welded tube.

Photograph B shows a typical tube supplied by Wallingford Steel. This tube was produced by the welding and cold drawing process, then inspected with a Magne Gauge to insure no ferrite was present in the weld metal. *Processed and inspected in this manner, Wallingford Cold Drawn Tube is guaranteed to show no preferential attack in weld area.*

All Wallingford welded stainless steel tubing is cold drawn and inspected by Magne Gauge. *Can your suppliers say this about the stainless steel tubing they produce?* Wallingford's manufacturing techniques and quality control checks assure top quality — *yet cost you no more.* Why not purchase *your* tubing where *tonnage is produced on a laboratory basis?*

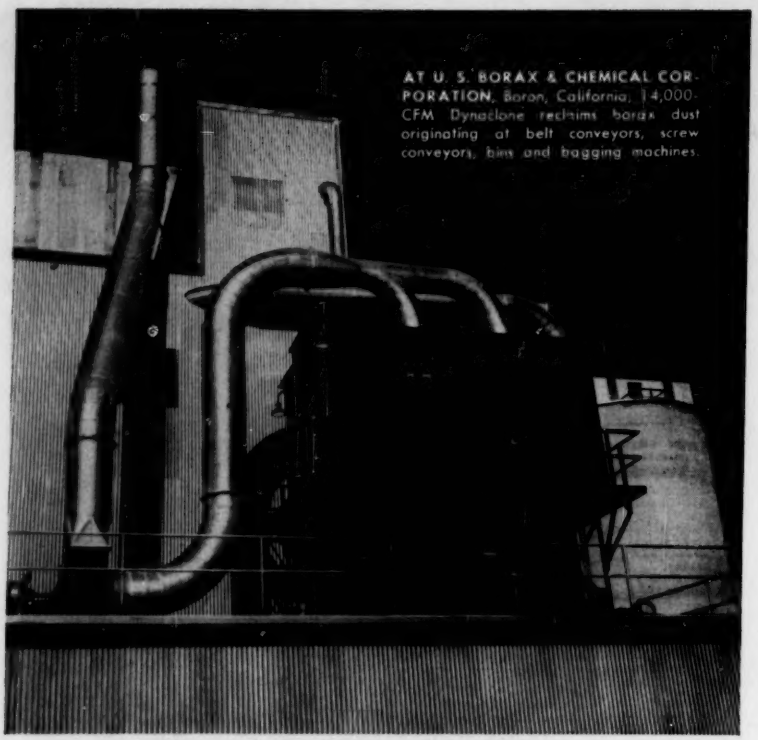
Write for our new Tubing Brochure to:
The Wallingford Steel Co., Wallingford, Connecticut.

THE WALLINGFORD STEEL CO.

Progress in Metals for over 37 Years

WALLINGFORD, CONN., U.S.A.

COLD ROLLED STRIP: Super Metals, Stainless, Alloy
WELDED TUBES AND PIPE: Super Metals, Stainless, Alloy


AT U. S. BORAX & CHEMICAL CORPORATION, Boron, California, 14,000-CFM Dynaclone reclaims borax dust originating at belt conveyors, screw conveyors, bins and bagging machines.

Constant Suction! Complete Collection!

SLY DYNACLONE®

The Dust Filter for Continuous Processes

Just turn this dust filter on and forget it. The Dynaclone operates continuously, 24 hours a day. It maintains constant, uniform suction at dust sources, reclaims all the dust to prevent air pollution and damage to plant equipment.

The Dynaclone has *new* "Resist-O-Wear" filter bags (patent pending) that give as much as three times longer bag life . . .

It has a new roller cleaner for simplified automatic self-cleaning. Resilient rubber rolls form a positive dust seal as each row of bags is cleaned by atmospheric air drawn in by the main operating fan.

And it contains more cloth per cubic foot of filter than any other make . . . greater filtering capacity with smaller space requirements.

Learn the many reasons why the Dynaclone represents a new high in dust filter efficiency . . .

Send for 36-Page Catalog 104

SINCE 1870 SLY

THE W. W. SLY MANUFACTURING CO.

4771 TRAIN AVENUE • CLEVELAND 1, OHIO
OFFICES IN PRINCIPAL CITIES

OVERSEAS LICENSEE: ANDREW AIR CONDITIONING LTD., LONDON S.W. 1, ENGLAND

60 mi. east of Havana. Plant will include a 125-ton/day ammonia unit, 150-ton/day nitric acid plant as well as facilities for ammonium nitrate, urea, nitrogen solutions and ammonium sulfate. Operations will start this summer, using imported ammonia; during latter part of 1960 ammonia will be made from imported bunker C oil.

Farbwerke Hoechst, West German chemical manufacturer, is now in the "advanced stages" of construction of the first plant for production of acetylene and ethylene via the Hoechst HTP process. Facilities, located at Frankfurt-Hoechst, will have an annual capacity of 100 million lb./yr. acetylene and ethylene.

Hungary has started production of dodecyl benzene, raw material for synthetic detergents, the Hungarian News & Information Service reports. Plant, at the Rakoskeresztur chemical works, will supply half of the country's requirements but no capacity figures were given out.

Shell Chemical has started up its new $18.2-million fertilizer plant at Shell Haven, Essex, England. Unit has capacity of 75,000 tons/yr. ammonia.

NEW LOCATIONS

Richardson Scale Co. has relocated its Western regional office. New address: 1369 Laurel St., San Carlos, Calif.

Texas-U.S. Chemical Co. will move its headquarters from New York to Port Neches, Tex. Details of the move have not been completed but was tentatively scheduled for early June.

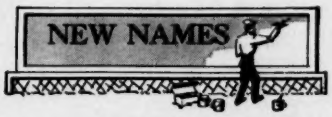
NRC Equipment Corp., producer of high-vacuum proc-

essing equipment, has established a West Coast engineering office in Palo Alto, Calif., at 499 Hamilton St., sharing quarters with the NRC regional sales office.

Chemore Corp., general representative in the U. S. and Canada for Montecatini, Milan, Italy, has moved its headquarters to 2 Broadway, New York 4, N. Y.

Gulf Oil has moved its manufacturing department headquarters to Houston, Tex. All five of Gulf's domestic refineries now report to Houston. Only department left in Pittsburgh is marketing.

Ciba Co. has moved from New York to new headquarters in Fair Lawn, N. J. Included in the move were the central staff, central warehouse facilities, sales office and laboratories.



The Texas Co. has officially changed its name to Texaco, Inc., to take advantage of the consumer recognition which its Texaco brand name has gained.

National Starch Products' stockholders have approved changing the corporate name to National Starch & Chemical Corp. Name change, says the firm, reflects the increasing importance of chemicals and chemical processes in the company's business.

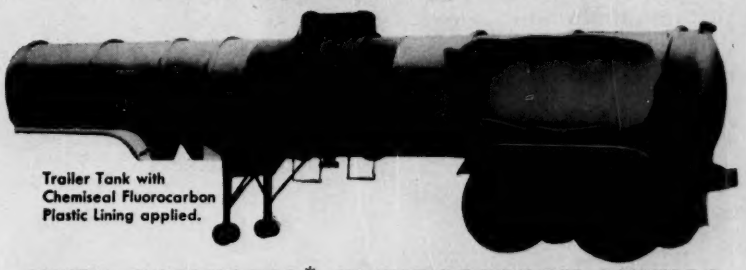
Uhde Corp. has changed its name to Hoechst-Uhde Corp. The firm is a subsidiary of Farbwerke Hoechst AG., and offers Hoechst processes for licensing.

Progressive Color & Chemical Co., New York, N. Y., has changed its name to Hostachem Corp., to identify itself more closely with the origin

Here's a real cost-saving idea!

CORROSION-PROOF

YOUR PRESENT EQUIPMENT . . .



Trailer Tank with Chemiseal Fluorocarbon Plastic Lining applied.

WITH CHEMISEAL* FLUOROCARBON LININGS

Instead of buying new equipment for corrosive service, simply have Chemiseal FLUOROCARBON PLASTIC LININGS applied to existing equipment. It's your assurance of positive chemical resistance without the high cost of special alloys, cladding, fused or baked linings!

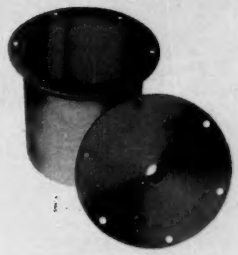
Hydrochloric, hydrofluoric, and nitric acids, plus the stronger alkalies, oxidants, and solvents, cannot harm Chemiseal FLUOROCARBON PLASTIC LININGS. They're easy to clean, non-brittle, non-contaminating, non-flammable, and can be used in temperatures ranging from −320°F to +250°F.

Most contours and materials (glass, wood, metal, concrete) can be covered easily and efficiently with Chemiseal FLUOROCARBON PLASTIC LININGS. Contact the skilled, factory-trained applicator nearest you for details on your application:

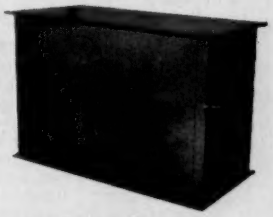
THE BARBER-WEBB COMPANY, INC., Los Angeles, Cal.
BELKE MFG. CO., INC., Chicago, Illinois
BUCKLEY IRON WORKS, Dorchester, Mass.
ELECTRO-CHEMICAL ENGRG. & MFG. CO., Emmaus, Pa.
LINCO, INC., Houston, Texas
METALWELD, INC., Philadelphia, Pa.

Or, write for Bulletin AD-152, Special Products Dept., United States Gasket Company, Camden 1, New Jersey.

*Registered trademark



Reactor Pot lined with Chemiseal Fluorocarbon Plastic.



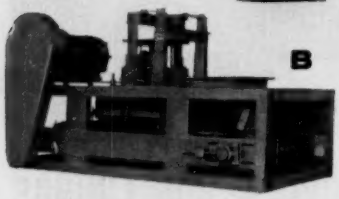
Fluoride Tank lined with Chemiseal Fluorocarbon Plastic.

Pipe Coupling with Chemiseal Fluorocarbon Plastic Lining.

United States Gasket — Plastics Division of GARLOCK

UNITIZED WEIGHER-FEEDER

Building-block design gives custom-made utility at an off-the-shelf cost



UNITIZED construction makes the W-C Weigher-Feeder readily adaptable to practically any processing setup. Components are standardized, proven and interchangeable . . . pre-engineered with virtual "plug-in" simplicity.

A The UPPER FRAME controls material input, is supplied with a rotary feeder, sliding gate, vibratory feeder or other mechanism matched to material and flow requirements.

B The CONVEYOR FRAME, where material is weighed, includes a complete conveyor section, weighing pan and transmitter with integral tare adjustment. W-C's system of flexure mountings assures accurate measurement despite uneven loading or pile-ups. There are no knife-edges, beam pivots or other points of concentrated wear to affect accuracy.

C The LOWER FRAME is optional; can be a simple chute as shown.

In addition, the W-C Weigher-Feeder is designed to handle such instrument-controlled functions as flow totalizing, recording, programming, and material proportioning. Units are also available for installation on existing conveyors.

Complete information is given in Catalog 12. Write for a copy

W-C

S.A. 1667

WEIGHING and Control COMPONENTS, Inc.

206-R Lincoln Ave., Hatboro, Pa.

FIRMS . . .

of its products—Farbwerke Hoechst of Frankfurt-Hoechst, West Germany.

NEW LINES

Fischer & Porter Co. announces formation of Warminster Fiberglass Co. for the production of fiberglass-reinforced plastic parts. New company will supply reinforced plastic parts for instrument manufacture.

U. S. Nuclear Corp. was recently formed to service isotope users; new company offers radiation sources, tracers, handling shielding, radiation decontamination and health physics services, is located in Burbank, Calif.

NEW REPRESENTATIVES

Chem-Guard Products, Inc., has appointed Duncan Equipment Co. of Seattle, Wash., as Washington-Oregon representative. Chem-Guard produces and markets corrosion-resistant paints and enamels.

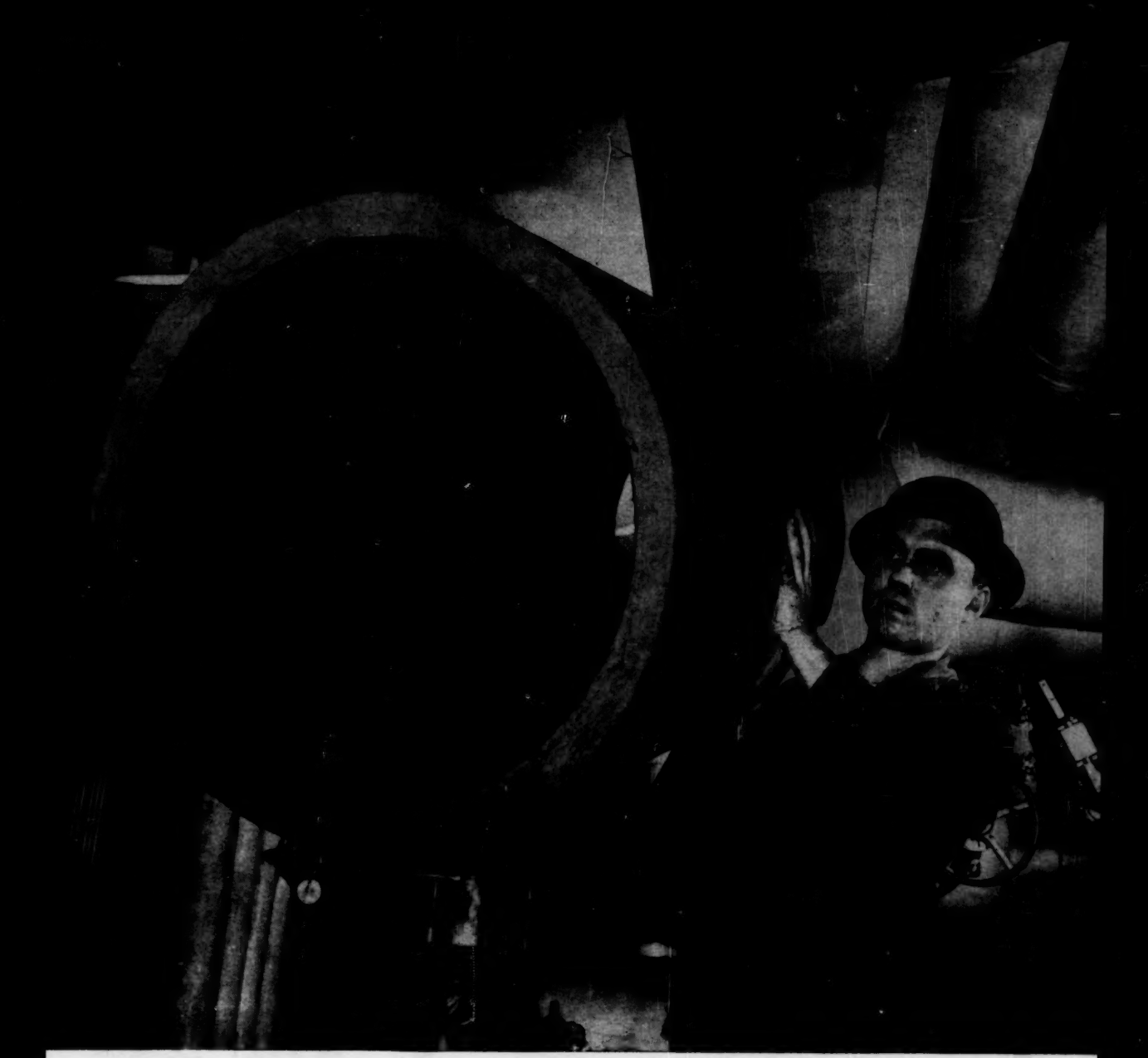
F. J. Stokes Corp., Philadelphia, Pa., and the French firm of Heurtey & Compagnie, Paris, have reached an agreement under which the French company will be licensed to build and sell Stokes-designed vacuum melting and heat treating furnaces abroad.

State Metals Div. of Winter, Wolff & Co., New York, has been appointed distributor for "Elechrome" high-purity chrome having 99.999% Cr content. Firm also handles high-vacuum melting furnaces for alloy production.

G-B SNAP*ON DISTRIBUTORS

(See ad on facing page)

AKRON, Ohio, The Asbestos Supply Co.
ALBANY, Ga., Industry Insulation Co.
ALBUQUERQUE, Mt. States Insulation Co.
AMARILLO, McDonald Engineering & Insulating Co.
ATLANTA, Ga., Reynolds Aluminum Supply Co.
AUSTIN, Texas, Cinbar Engineering Co.
BALTIMORE, Md., Leroy Insulation Co.
BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Shook & Fletcher Supply Co.
Reynolds Aluminum Supply Co.
BOSTON, Homans-Kohler, Inc.
BUFFALO, Industrial Insulation Sales, Inc.
CHARLESTON, W. Va., Baldwin Asbestos Products Co.
CHARLESTON HEIGHTS, S. C., Stafford Insulation Co.
CHICAGO, E. C. Carlson Co.
Culberg Asbestos & Cork Co.
CHILLICOTHE, Ohio, Southern Ohio Insulating Co.
CLEVELAND, Ohio Asbestos and Insulation Co.
COLUMBIA, S. C., Industrial Insulation
Div. of Richland Oil Co.
COLUMBUS, Culberg of Ohio
Santeler Brothers
CORPUS CHRISTI, Precision Insulation Co.
DALLAS, Insulation Supply Co., Inc.
Payne-Ladewig, Inc.
DAVENPORT, Republic Electric Co.
DENVER, Gene Wright Lumber Co.
Powers Industrial Insulation, Inc.
DES MOINES, Iowa Asbestos Co., Inc.
EL PASO, Insulation Specialties Co.
EVANSVILLE, Ind., George Koch Sons, Inc.
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
FT. WORTH, The Bracken Co.
GREENSBORO, N. C., Starr Davis Co., Inc.
GULFPORT, Miss., Paine Supply Co.
HOUSTON, Precision Insulation Co.
INDIANAPOLIS, Central Supply Co.
JACKSON, Miss., Paine Refrigeration & Supply Co.
JACKSONVILLE, Ferber Sheet Metal Works
Reynolds Aluminum Supply Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Central Supply Co.
LITTLE ROCK, Gunn Distributing Co.
LOS ANGELES, Thorpe Insulation Co.
Western Fibrous Glass Products Co.
LOUISVILLE, General Insulation & Roofing Co.
MACON, Ga., Industry Insulation Co.
MEMPHIS, John A. Denie's Sons Co.
MIAMI, Crabtree Insulation Co.
Reynolds Aluminum Supply Co.
Southern Metals Co.
MILWAUKEE, F. R. Dengel Co.
MINNEAPOLIS, Asbestos Products, Inc.
NASHVILLE, Reynolds Aluminum Supply Co.
NEWARK, N.J., Eastern Steam Specialty Co.
NEW ORLEANS, Eagle Asbestos & Packing
NEW YORK, Eastern Steam Specialty Co.
Hudson Valley Asbestos Corp.
OKLAHOMA CITY, Ball Distributing & Engineering Co.
OMAHA, Cardinal Supply & Mfg. Co.
ORANGE, Conn., Insulation Supply Co.
PADUCAH, Ky., Triangle Insulation Co.
PHILADELPHIA, John F. Scanlan, Inc.
PHOENIX, Ariz., Kircher Asbestos & Rubber Co.
PITTSBURGH, Dravo Corp.
PORTLAND, ORE., Western Fibrous Glass
RALEIGH, N.C., Reynolds Aluminum Supply Co.
RAPID CITY, S. D., Robbins & Stearns Wholesale
RICHMOND, Va., Reynolds Aluminum Supply Co.
ROANOKE, Va., C. E. Thurston Co.
ROCKFORD, Ill., Mott Brothers Co.
SALT LAKE CITY, Bullough Asbestos Supply Co.
SAN ANTONIO, The Bracken Co.
SAN DIEGO, Western Fibrous Glass Products
SAN FRANCISCO, Western Fibrous Glass Products
SAVANNAH, Ga., Reynolds Aluminum Supply Co.
SEATTLE, Western Fibrous Glass Products
ST. LOUIS, Hollander & Co., Inc.
The Stovey Company, Inc.
ST. PAUL, Asbestos Products, Inc.
SULLIVAN, Ill., Lewie David, Inc.
TALLAHASSEE, Fla., Bakers, Inc.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
VANCOUVER, B. C., Fleck Brothers Limited
WASHINGTON, D. C., Walter E. Campbell Co.
WICHITA, General Metals, Inc.



They compared "K" factors and cost factors . . . and bought G-B SNAP*ON®

FOR FREE TEVA SURVEY CALL YOUR LOCAL G-B SNAP*ON DISTRIBUTOR (LISTED IN ADJOINING COLUMN)

Here's how you can reduce the cost of insulating large pipe — simply use G-B Snap*On, the original one-piece pipe insulation molded of fine glass fibers. You can use G-B Snap*On in thinner wall thicknesses—*and obtain the same, or superior insulating efficiency*—for G-B Snap*On's thermal efficiency is unique among general-purpose pipe insulations. Application couldn't be easier or more economical—particularly when you use big 6′ one-piece sections that snap on big pipe quicker than you can say "G-B Snap*On!"

Compare these and many other G-B Snap*On advantages by asking your G-B distributor to make a TEVA (Thermo-Economic Value Analysis) survey the next time you plan to insulate piping, be it hot or cold, large or small, indoors or out. G-B Snap*On is available in the *complete* range of sizes from copper tubing to 36″ IPS . . . plain, or with a variety of weatherproof and vapor barrier jackets.

GUSTIN-BACON *Manufacturing Co* GUSTIN gb BACON

252 W. 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations . . . molded glass fiber pipe insulation
Couplings and fittings for plain and grooved end pipe

DO YOU
GENERATE YOUR OWN INERT GASES?

Using Mathieson CO_2 may be cheaper, cleaner, safer and more efficient

Generators are expensive to buy, operate and maintain while replacement costs are very high.

Use of Mathieson CO_2 eliminates generators and all their associated expense.

Gas generators are slow to get into action . . . very inflexible.

CO_2 is available instantly at all times.

Unless precise metering of fuel is maintained at all times, carbon monoxide may be produced, or all the oxygen may not be consumed.

No metering of fuel required at all. Mathieson CO_2 is uniformly pure at all times.

Produces large amounts of water vapor, necessitating driers.

No water vapor present. No driers needed.

Where inerts are needed under pressure, a compressor must be used.

CO_2 has high vapor pressure at all times.

Reserve storage is a problem in case of stoppages in the generator. Small amounts of generated inerts can be stored, but only as a compressed gas.

Your supply of CO_2 is unaffected by stoppages in equipment or in fuel supply. Large amounts of CO_2 are stored as a liquefied gas.

Sulfur compounds and other contaminants may appear, due to fuel used.

Mathieson CO_2 is uniformly pure at all times.

Gas generators consume valuable floor space.

Use of Mathieson CO_2 requires little floor space or none at all.

Operation may create fumes, dirt, toxic gases.

No fumes, no dirt, no toxic gases.

HERE ARE SOME OF THE IMPORTANT CHARACTERISTICS OF CO_2 VAPOR

Molecular weight	44.004
Specific gravity	1.527 (when air equals 1) 1.557 (when N_2 equals 1)
Absolute density	0.114 lb./cu. ft. @ 70° F.
Thermal conductivity	0.590 (air equals 1)
Specific heat	0.19 to 0.21 BTU/lb.
Volume, cu. ft./lb.	8.79 @ 70° F.
Pressure, saturated	852.5 psia @ 70° F.
Cost, 100 cu. ft.	$0.455 ($CO_2$ costing $.04/lb.)

Compare the advantages of Mathieson CO_2 with the problems involved in generating your own inerts by burning out the oxygen in air to arrive at nitrogen plus carbon dioxide. Then contact your Olin Mathieson representative for full details.

5980-A

MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
CHEMICALS DIVISION • BALTIMORE 3, MD.

CALENDAR

Chemical Society of London, symposium on fluorine chemistry.
July 15-17 Birmingham, England

Gordon Research Conference: Corrosion, Colby Junior College.
July 20-24 New London, N. H.

Gordon Research Conference: Radiation Chemistry, New Hampton School.
July 27-31 New Hampton, N. H.

Gordon Research Conference: Organic Coatings, Colby Junior College.
July 27-31 New London, N. H.

National Soybean Processors Assn.-American Soybean Assn., joint annual meeting, Sheraton-Jefferson Hotel.
Aug. 10-12 St. Louis, Mo.

American-Pharmaceutical Assn., annual meeting, Netherland-Hilton Hotel.
Aug. 16-21 Cincinnati, Ohio

Gordon Research Conference: Chemistry and Physics of Metals, Kimball Union Academy.
Aug. 17-21 Meriden, N. H.

Technical Assn. of the Pulp and Paper Industry, 10th Testing Conference, Multnomah Hotel.
Aug. 18-21 Portland, Ore.

International Union of Pure and Applied Chemistry, symposium: Chemical Thermodynamics.
Aug. 20-25 Wattens, Austria

American Rocket Society, symposium: Gas Dynamics, Northwestern University.
Aug. 24-26 Evanston, Ill.

Gordon Research Conference: Instrumentation, Colby Junior College.
Aug. 24-28 New London, N. H.

Chemical Institute of Canada, Physical Chemistry Div. meeting, McMaster University.
Aug. 30-Sept. 1 Hamilton, Ont.

International Union of Pure and Applied Chemistry, symposium: Thermodynamics and Thermochemistry.
Aug. 30-Sept. 6 Munich, Germany

Assn. for Computing Machinery, national meeting, Mass. Institute of Technology.
Sept. 1-3 Cambridge, Mass.

Cryogenic Engineering Conference, University of California.
Sept. 2-4 Berkeley, Calif.

Ion Exchange Conference, Mountain View Hotel.
Sept. 7-11 Gatlinburg, Tenn.

American Society of Mechanical Engineers, Wood Industries Div., national meeting.
Sept. 10-11 Portland, Ore.

American Society of Mechanical Engineers, International Air-Pollution Congress, Statler-Hilton Hotel.
Sept. 10-11 New York, N. Y.

Society of Plastics Industry, midwest conference.
Sept. 10-11 French Lick, Ind.

Armed Forces Chemical Assn., annual meeting, Hotel Statler.
Sept. 10-11 New York, N. Y.

American Chemical Society, national meeting.
Sept. 13-18 Atlantic City, N. J.

Canadian Agricultural Chemicals Assn., annual meeting, Chateau Frontenac.
Sept. 20-23 Quebec City, Que.

Chemical Market Research Assn., conference: Textile Fibers.
Sept. 20-22 Williamsburg, Va.

Technical Assn. of the Pulp and Paper Industry, 14th Paper-Plastics Conference, Edgewater Beach Hotel.
Sept. 21-23 Chicago, Ill.

Instrument Society of America, 14th annual Instrumentation-Automation Conference and Exhibit, Amphitheatre.
Sept. 21-25 Chicago, Ill.

American Rocket Society, conference on solid propellants, Princeton University.
Sept. 24-25 Princeton, N. J.

American Society for Quality Control, Chemical Div., annual conference, Shamrock-Hilton Hotel.
Sept. 24-25 Houston, Texas

International Union of Pure and Applied Chemistry, 20th conference.
Sept. 26-29 Munich, Germany

American Institute of Chemical Engineers, national meeting, Hotel St. Paul.
Sept. 27-30 St. Paul, Minn.

American Oil Chemists Society, fall meeting, Statler Hotel.
Sept. 28-30 Los Angeles, Calif

American Gas Assn., national convention, Conrad-Hilton Hotel.
Oct. 5-7 Chicago, Ill.

International Symposium on High-Temperature Technology, arranged by Stanford Research Institute.
Oct. 6-9 Asilomar, Calif.

Society of Plastics Engineers, Technical meeting: Vinyl Plastics.
Oct. 7 Cleveland, Ohio

American Vacuum Society, annual meeting, Penn Sheraton Hotel.
Oct. 7-9 Philadelphia, Pa.

Assn. of Official Agricultural Chemists, annual meeting, Shoreham Hotel.
Oct. 12-14 Washington, D. C.

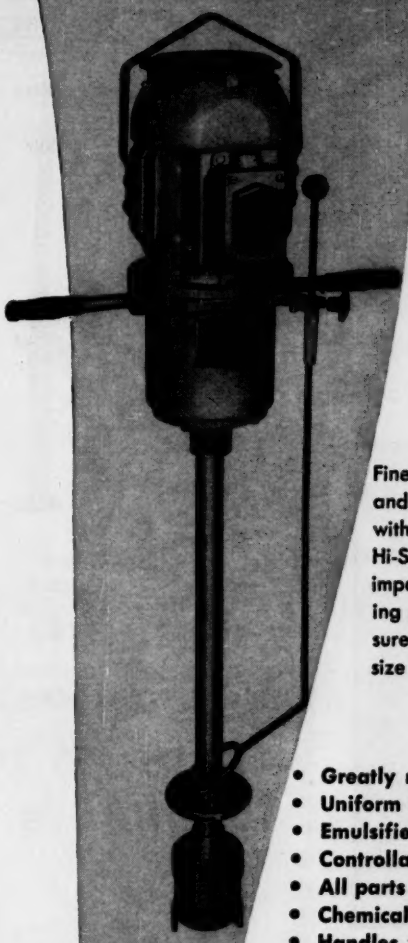
Technical Assn. of the Pulp and Paper Industry, engineering conference, Penn Sheraton Hotel.
Oct. 12-15 Pittsburgh, Pa.

International Fair of the Plastics Industry, Europe Hall.
Oct. 17-25 Dusseldorf, W. Germany

American Coke & Coal Chemicals Inst. annual meeting, Greenbrier.
Oct. 19-20 White Sulphur Spa., W. Va.

American Standards Assn., national conference, Sheraton - Cadillac Hotel.
Oct. 20-22 Detroit, Mich.

SHEAR-FLOW



the modern mixer with power shearing

Finer, faster blending, dispersing and homogenizing is now possible with Shear-Flow's new Model RL Hi-Shear Head. Finely spaced dual impellers induce considerable shearing action and high pumping pressures that rapidly reduce particle size for superior material mixtures.

- **Greatly reduces mixing time**
- **Uniform circulation—no vortex**
- **Emulsifies immiscible liquids**
- **Controllable flow pattern**
- **All parts stainless steel**
- **Chemically inert seals**
- **Handles viscous materials with ease**
- **No operating Torque**
- **Disperses, blends, homogenizes**

SHEAR-FLOW
GABB SPECIAL PRODUCTS INC.

GABB SPECIAL PRODUCTS INC.
Windsor Locks, Conn.

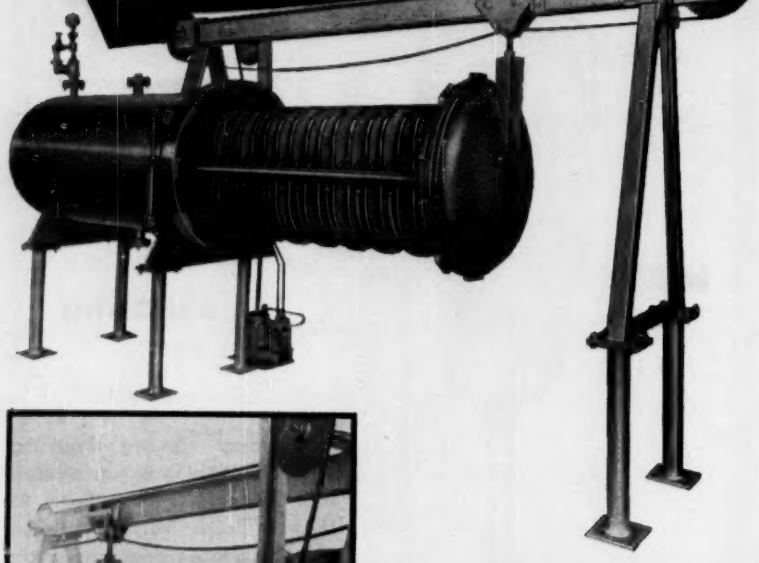
☐ Have representative call for demonstration
☐ Send more information

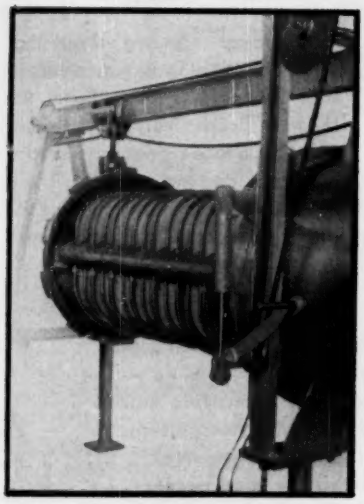
Name_____

Position_____

Co. & Address_____

No other pressure filter like it





SHRIVER takes a fresh approach to leaf filters

Here are new design features based on a well rounded 50-year knowledge of pressure filtration applications.

These illustrations, for example, show some novel and important improvements in leaf retraction mechanism and cake discharge, calculated to facilitate operation and cleaning.

Let us show you how the new Shriver filter improvements can help solve your filtration problems. Write for Bulletin 146.

T. SHRIVER & COMPANY, INC.
802 HAMILTON STREET • HARRISON, N. J.
SALES REPRESENTATIVES IN: Chicago, Ill.—Atlanta, Ga.—Houston, Tex.—Detroit, Mich. St. Louis, Mo.—San Francisco, Cal.—Montreal, Que.—Toronto, Ont.

FILTER PRESSES • VERTICAL LEAF FILTERS • FILTER MEDIA
HORIZONTAL PLATE FILTERS • CONTINUOUS THICKENERS
SLAB FORMERS • DIAPHRAGM PUMPS • ELECTROLYTIC CELLS

NEW EQUIPMENT . . .

(*Continued from p.* 106)

low-pressure pumping system to the processing equipment.

Both single-pass and three-pass heaters are available. The single-pass series comes with outputs ranging from 500,000 to 2½-million Btu./hr.; capacities with the three-pass units run from 2½- to 10-million Btu./hr. In all, eight models are now offered. — **Allis-Chalmers Mfg. Co., Milwaukee, Wis.** 160E

Radiation Clothing

Full line protects nuclear-systems workers.

A new, complete line of protective clothing for use in nuclear systems work is being offered by Industrial Products Co. The line includes: hats, shirts, pants, lab coats, aprons, boots, shoe covers and translucent Pylox gloves. Modestly priced, the garments are made of a nonwoven, fabric-reinforced, high-strength nylon thread. Surfacing is cellulose wadding, specially treated for fire-resistance and water repellency. — **Industrial Products Co., Philadelphia, Pa.** 198A

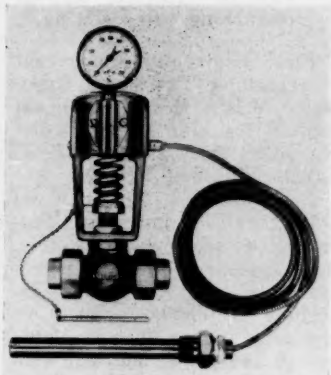
Composite Container

For corrosive, poisonous, flammable liquids.

Steel pails having seamless, blown-in-one-piece polyethylene plastic liners have been ap-

proved by the Bureau of Explosives to carry certain corrosive, poisonous and flammable liquids under ICC-37P specifications.

Having a minimum wall thickness of about 10 mils, the liner is attached to the cover of the outer steel container at the pouring opening before it is inserted into the container. Called JaLiner, the composite container is now available in a 5-gal. size. The 1- and 15- gal. sizes are currently under development. Tare weights and shipping cubes of the JaLiner package are less than for returnable containers.—**Jones & Laughlin Steel Corp., Pittsburgh, Pa.** 198B



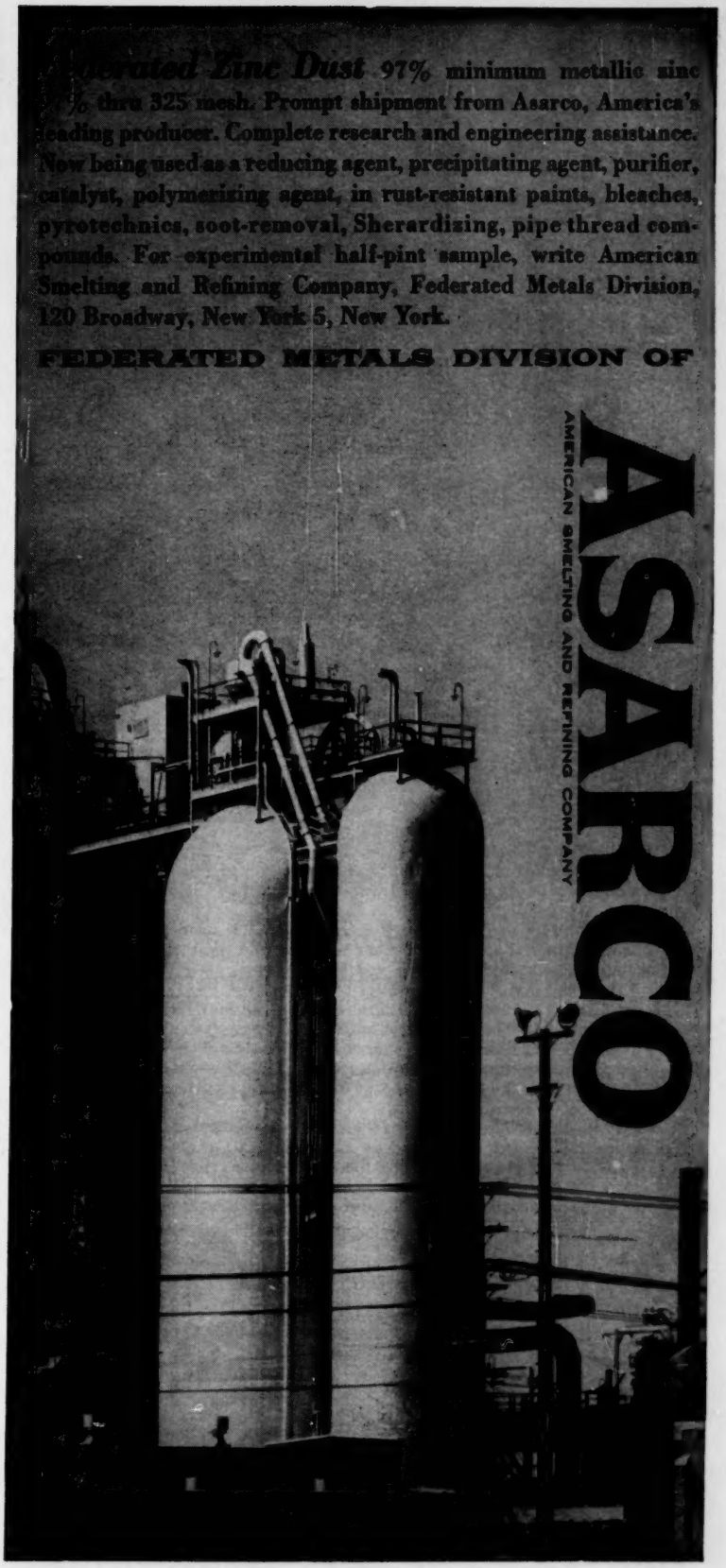
Temperature Regulator

Corrective action within 1/10 of a degree.

Temperature control through the throttling action of a valve on steam or water lines is the principle of operation of the new American temperature regulator. Corrective stroke begins with less than 0.1° F. change in temperature at the bulb.

Friction-free bellows seal the regulator's valve stem. This does away with stem-binding problems common to stuffing boxes. An internal safety spring protects the regulator against damage in accidental overheating.

Two models are available; one is indicating, the other non-indicating. Both types are offered in sizes from ½ to 2 in. Ranges are from −15/50 F. to


Federated Zinc Dust 97% minimum metallic zinc
thru 325 mesh. Prompt shipment from Asarco, America's
leading producer. Complete research and engineering assistance.
Now being used as a reducing agent, precipitating agent, purifier,
catalyst, polymerizing agent, in rust-resistant paints, bleaches,
pyrotechnics, soot-removal, Sherardizing, pipe thread com-
pounds. For experimental half-pint sample, write American
Smelting and Refining Company, Federated Metals Division,
120 Broadway, New York 5, New York.
FEDERATED METALS DIVISION OF
ASARCO
AMERICAN SMELTING AND REFINING COMPANY

THERE'S ECONOMY IN QUALITY...*for everyone concerned!*

from LINING ENGINEERING CORPORATION

NEW and BETTER PROTECTIVE COATINGS for PAILS and DRUMS

...at Less Cost!

NEW—A full range of custom coatings for producers and users of *lined* pails and drums . . . from a pioneer manufacturer and applicator of high bake lining materials.

BETTER—with superior film coverage, easier application and greater economy. Here, too, is the excellent adhesion you want, the high film strength, the desired flexibility and quality.

LEC *Linings are available in 3 custom formulated consistencies:—*

1) Ready for spray—without thinning.
2) Ready for hot spraying—without thinning.
3) High solids formulations—for economical in plant reduction to normal or hot spray.

LEC Linings are also available either clear or pigmented.

We invite your inquiry and offer field technical service and advice.

Ask for your LEC *brochure*

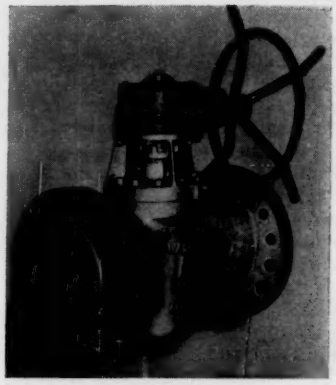
Printed in loose-leaf form, the brochure contains a full description of each coating including specifications, application data, baking instructions and suggestions and related data. Ask for brochure LEC-1.

LINING ENGINEERING CORPORATION
5000 W. Lake St., Melrose Park, Ill.
42 Belden Ave., Norwalk, Conn.
36 W. 44th St., New York 36, N. Y.

A Division of Lithcote Corporation

NEW EQUIPMENT . . .

240/350 F.—Manning, Maxwell & Moore, Stratford, Conn. 199A

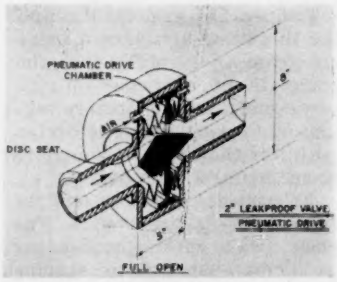


Gear Assembly

Can be removed without disturbing valve setting.

First displayed at the recent International Petroleum Exposition, Walworth's new gear assembly for plug valves is designed to replace worm-geared ball bearing devices.

Chief feature of such valves is that the gear unit is an all-in-one, oil-filled, sealed assembly. This enables installation or removal of gearing without disturbing factory adjustment of the plug. Sizes now available are 10 and 12 in., 300- and 400-lb.; and 10 in., 600-lb.—**Walworth Co., New York, N. Y. 200A**



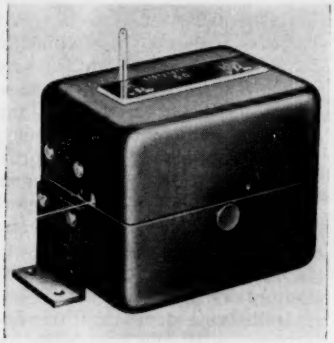
Leakproof Valve

No connection between fluids and atmosphere.

Suitable for either tight shut-off or automatic throttling of gases and liquids, a new, leak-proof valve has no moving parts

between fluid chamber and the atmosphere. Primary application for the valve is safe handling of radioactive and toxic fluids. Limits of design working temperature are —20 and 1,500 F.; design working pressures range from 0.005 microns vacuum to 150 psig. in smaller sizes, and to 30 psig. in sizes up to 72 in. diameter.

Heart of the valve is a standard commercial bellows that forms the fluid chamber. The chamber contains only a seat and disk. There is no opening to the atmosphere—no stuffing box or valve stem. Either pneumatic or mechanical drives will open and close the disk.—**Singmaster & Breyer, New York, N. Y.** 200B



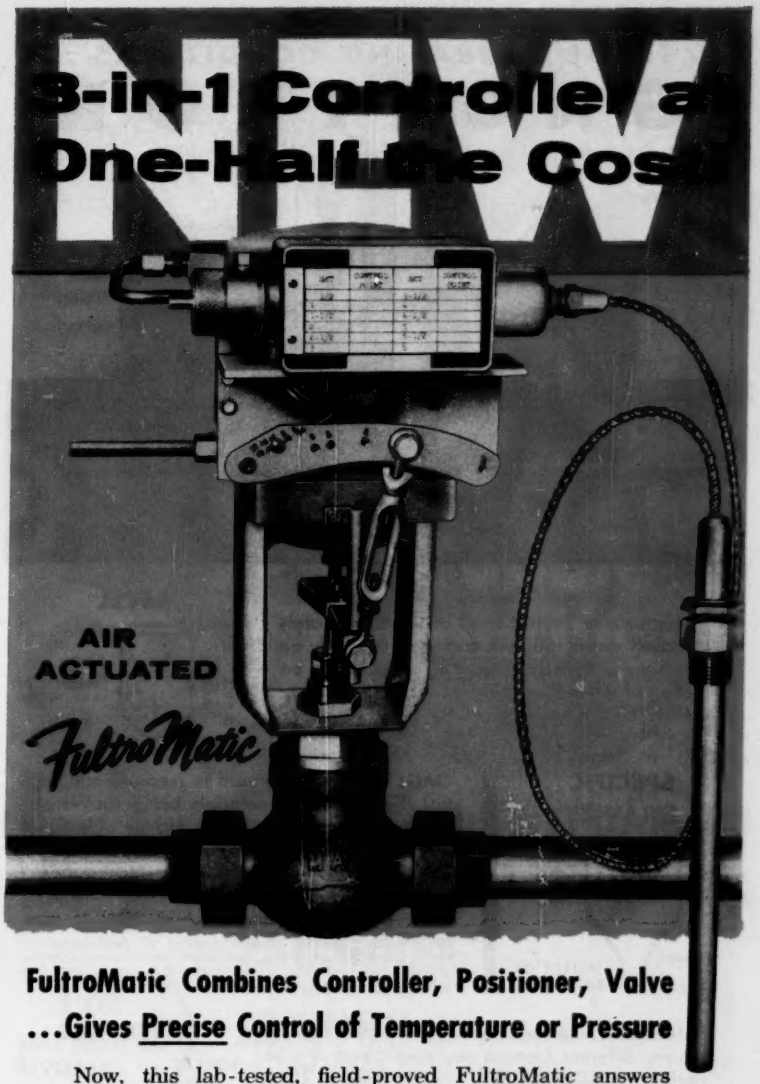
Force Amplifier

Device can replace electronic servomechanisms.

Most mechanical elements for measuring flow, pressure and temperature often require some amplification of output to position automatic controls, recorders or other devices. A new force amplifier can be actuated directly by such measuring elements, eliminating the need for electronic amplifiers and servos. Operating principle can be compared with a variable-pitch lead screw.

Starting power can be supplied by any external source, such as a subfractional-horsepower motor.

For input forces less than 1 g., output is precisely positioned with forces up to 500 g. Linear output motion is identical to input motion within 0.001 in. Use-



FultroMatic Combines Controller, Positioner, Valve ...Gives Precise Control of Temperature or Pressure

Now, this lab-tested, field-proved FultroMatic answers today's precise control requirements with multiple features never before available in one unit . . . *at about half the cost of two- and three-unit systems!*

- **Improved accuracy** with smaller, faster-responding element.
- **Positive valve positioning** by feedback action; no overshoot.
- **Adjustable proportional band** easily changed on the job.
- **Simplified settings** with knob, indicator, arbitrary scale.
- **Field reversibility:** control action quickly changeable.
- **Easy to install:** place valve in position, mount bulb, connect air.
- **Low maintenance:** rugged design for trouble-free service.

FOR COMPLETE FULTROMATIC SPECIFICATIONS, WRITE FOR BULLETIN NC-755

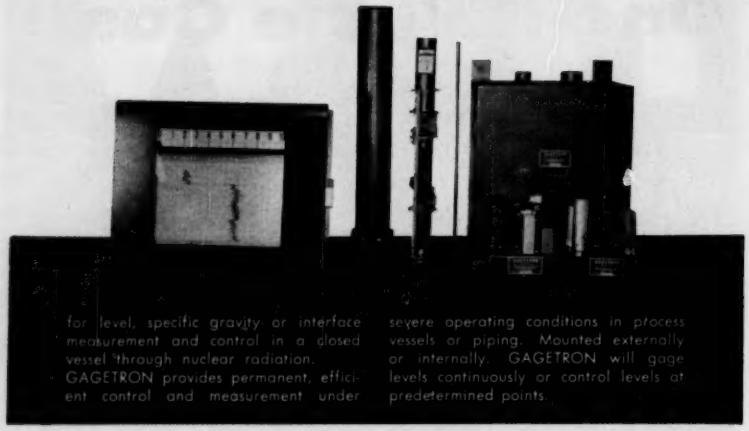
Mr. Controls

Robertshaw-Fulton CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

MEASUREMENT AND CONTROL UNDER EXTREME OPERATING CONDITIONS . . .

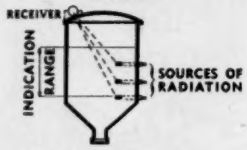
GAGETRON®



for level, specific gravity or interface measurement and control in a closed vessel through nuclear radiation. GAGETRON provides permanent, efficient control and measurement under severe operating conditions in process vessels or piping. Mounted externally or internally, GAGETRON will gage levels continuously or control levels at predetermined points.

Multiple sources of radiation usually required to measure or control level of liquids or solids in closed vessel. Sources arranged vertically on vessel wall. Specific gravity of materials to be measured determines distance between sources. GAGETRON is used NOW for polyethylene, coke and catalyst, uranium ore and liquid ammonia level.

LEVEL

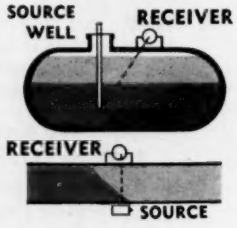


SPECIFIC GRAVITY

GAGETRON may be used to measure and control the density of materials being discharged from a hopper. The specific gravity of practically any material can be successfully controlled. Located outside the vessel, the detecting device is not affected by extreme temperatures or pressures within the vessel. GAGETRON is used NOW for specific gravity control of dextro-maltose syrup, density control on lead slurry autoclaves, specific gravity measurement of ammonia slurries containing solids, density control of asbestos cement slurry.

Detection of interface position between materials having different Gamma ray coefficients can be performed ACCURATELY with the GAGETRON. Tank installations may be made either internally or externally, depending on tank design and user preference. Pipeline installations are easily made by locating source diametrically opposite the detector. GAGETRON is used NOW for interface detection of refined petroleum products in pipeline, acid/hydrocarbon interface measurement in extraction column, interface control of saturated brine/solid salt bed in evaporator, water/acid interface control in settling tank.

INTERFACE



SPECIFICATIONS

Power: 105-125 VAC, 50-60 cps
Output Impedance: 0-500 ohms
Output Power: At 500 ohms impedance, 40 mv. at 10 counts per sec.
Variation of Output: With counting rate at 10 counts/sec. at 500 ohms and 20 sec. counter time constant is 5%. Normal operating condition; 250 ohms output at 70 cps for 40 mv. with 20 sec. time constant variation is 2%.

INSTRUMENTS INCORPORATED TULSA

INSTRUMENTS, INC.

BOX 556 • TULSA, OKLAHOMA

PIONEERS IN LEVEL MEASUREMENT AND CONTROL INSTRUMENTATION

ful travel is 2.0 in. Prices start at $250.—**American Meter Co., Garland, Tex.** 201A

Unspliced Hose

Length is limited only by transportation facilities.

Large-diameter hose without splices is now available in lengths limited only by the size of transportation facilities handling it. First production via the new manufacturing process was devoted to military projects—4-in. hose was produced in 500-ft. lengths to transport military fuels. Expected commercial uses vary from offshore unloading of tankers to temporary pipelines.

Industrial users will realize savings with the new hose because couplings and troublesome splices are eliminated. The production process can be adjusted to produce hose in sizes from 2 to 8 in. I. D.—**Goodyear Tire & Rubber Co., Akron, Ohio** 202A

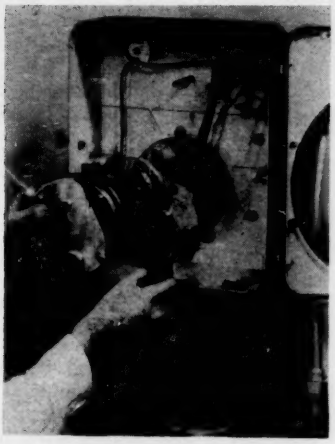
Plastic Pipe Fittings

For either threaded or plain-end pipe.

New fittings for the manufacturer's Bondstrand reinforced plastic pipe include 90- and 45-deg. ells, tees, couplings, with either threaded or plain ends. Fittings having plain ends are connected by a patented locking-wedge feature.

Ductile iron flanges with the locking-wedge feature are also in stock. These are designed so that pipe contents cannot

contact the iron. A second type of flange now being developed will be fabricated entirely of Bondstrand material. Flanged and Victaulic-type fittings made entirely of glass fibers and epoxy resin are also in the works.—**Amercoat Corp., South Gate, Calif.** **202B**



Gas Drive

Operates indefinitely if gas supply available.

Gas-propelled chart drives, claimed to operate indefinitely and without attention as long as gas pressure is available, are applicable to remote-location installation where it is not possible to manually wind standard chart drives. The drive operates at 25-psi., and rotates the main arbor once every 24 hr., delivering 12 in.-lb. torque.

Gas consumption is 4 cfd. Accuracy of the explosion-proof instrument is unaffected by supply-pressure fluctuations.—**Rockwell Mfg. Co., Pittsburgh, Pa.** **203A**

Impeller Coatings

Coating protects against sparking and corrosion.

Kanigen, a special coating that protects against sparking and corrosion, is now available on impellers of the complete Sutorbilt line of gas pumps. The coating, developed by the Kanigen Div. of General Amer-

get a Dow Corning SILICONE DEFOAMER!

Is *foam* robbing you of production? Stamp it out *fast* with a Dow Corning SILICONE DEFOAMER—the most effective foam killers ever developed.

1 oz kills foam in:

250,000 lb molasses, vat dye solution, trioxide pickling solution, tall oil

125,000 lb phenolformaldehyde, urea formaldehyde, asphalt, starch sizing

62,500 lb soft drinks, 70% caustic liquor, black liquor, sulfuric acid pickling bath, hexane-soya oil extract

FREE SAMPLE! Make your own test. Return coupon below for generous *trial sample* of a Dow Corning SILICONE DEFOAMER. No obligation, of course.

first in silicones **Dow Corning CORPORATION**
MIDLAND, MICHIGAN

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NAME

TITLE

COMPANY

CITY ZONE STATE

My foamer is

Oil system

Aqueous system

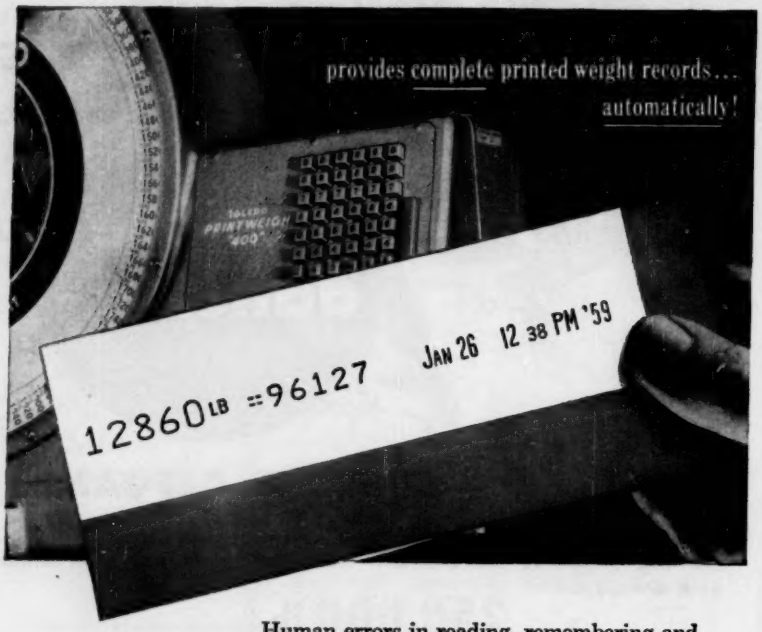
Food products

Other

BAN this "birthplace of losses"

. . . hand-written weight records!

NEW TOLEDO PRINTWEIGH® "400"



Human errors in reading, remembering and recording weights *are eliminated* with new Toledo Printweigh "400" . . . product of Toledo's advanced research and development programs to improve weighing efficiency.

Printweigh "400" provides *complete* printed weight records on materials received, processed, transferred or shipped. It's applicable to the full range of Toledo dial scales . . . offers a wide choice of optional features, including a "memory" for printing weight data even after the load is removed.

Printweigh "400" prints full figures, even when using unit weights . . . prints where you wish on 8½" x 11" forms, or on tickets or strips . . . and for positive weight identification, offers 6 to 12 bank selective numbering, or up to 10 weight identifying symbols. Automatic five digit consecutive numbering is also available.

REMOTE RECORDING, TOO!
Printweigh "400" can give wings to weight data by transmitting it to remotely located adding or other office machines. Brings new flexibility and accuracy to weighing operations.

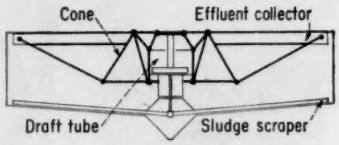
SEND FOR Printweigh "400" bulletin 1157. Or, ask your Toledo representative. TOLEDO SCALE, Division of Toledo Scale Corporation, 1403 Telegraph Rd., Toledo 12, Ohio.

SERVICE Factory-Trained 248 Cities

TOLEDO®
greatest name in weighing

ican Transportation Corp., is a deposit of uniform, hard, corrosion- and abrasion-resistant nickel alloy.

Sutorbilt gas pumps are offered in both horizontal and vertical design. Standard units have right-hand drive shaft and bottom discharge; left-hand units are available if specified. —**Sutorbilt Corp., Compton, Calif.** **203B**



Truss Redesign

Lowers cost of large-size liquid clarifiers.

A new, patented truss design makes possible the economical construction of Graver's Reactivator solids-contact units in almost unlimited sizes. Fabricated almost entirely of functional members, Inverta-Truss design provides support for all internal equipment without resorting to a conventional truss bridge.

Graver states that costs normally rose sharply for construction of Reactivators over 75 ft. in diameter. The rise was due to an increased amount and thickness of steel required for long and sturdy bridge trusses, and to the extra foundation work and reinforcement needed for truss supporting members. Use of functional members cuts steel costs. And by distributing the stress evenly, it eliminates the need for reinforcement at localized points.—**Graver Water Conditioner Co., New York, N. Y.** **204A**

BRIEFS

Bimetallic thermometers calibrated for accuracy of ±1% of range over entire scale feature all stainless steel construction, including the welds. Ranges vary from −100/1,000 F. to 100/500 C. The units come with either

3- or 5-in. dia. heads and a wide variety of stem lengths. —**Weston Instruments Div., Newark, N. J.** **204B**

Explosion-proof fittings, GEJ series, are available in a complete line of hub styles with 1½- and 2-in. hubs of aluminum alloy. The fittings measure 6 $\frac{3}{16}$ in. dia. and 3½ in. deep. Blank flat as well as deep dome covers for Class I, Groups C & D; Class II, Groups E, F & G.—**Kilark Electric Mfg. Co., St. Louis, Mo.** **205A**

Packing for polish-rod stuffing boxes and slush pumps has three to five times the life of ordinary packing, according to the manufacturer. Called Red Dog, the packing is molded from neoprene to resist oil, oxidation, abrasion. —**Pacific Moulded Products, Los Angeles, Calif.** **205B**

Submersible motor designed to drive deep-well turbine pumps is protected by highly dielectric insulation system, by encapsulation in a chemically inert plastisol and by sealing in stainless steel. Ratings offered for the 4-in. unit in single-phase construction vary from 1½ to 5 hp. In three-phase construction, ratings extend from 1½ to 7½ hp. at 3,550 rpm.—**Louis Allis Co., Milwaukee, Wis.** **205C**

Dall flow tubes made of plastic are now offered in sizes 4 through 48 in. Design features include self-contained instrument caps, low head loss, low weight, high accuracy, maximum corrosion resistance and lower cost. Materials of construction include glass-fiber-reinforced epoxy or polyester resins for the body, and metallic throat linings. — **B-I-F Industries, Inc., Providence, R. I.** **205D**

Integral steam tracing of the Unitrace line is now available with an outside diameter equal to 8-in. pipe. Fittings developed to incorporate Unitrace into standard piping systems include a new flange, adapter flange, and 90-deg.

NEROFIL

The Carbon-Based Filteraid for Caustic, Acid, Sulphur and Other Difficult Filtrations such as Fluorated Solutions.

NEROFIL, available in 6 grades to meet all needs for high clarity and fast flowrate, is produced and sold by the Great Lakes Carbon Corp. whose Dicalite Dept. long has been a leader in the filtration industry.

✔ ***Check these NEROFIL Advantages!***

Not just crushed carbon, but a genuine filteraid specially processed for greater porosity and maximum surface area, NEROFIL is giving excellent results where no other filteraid had ever been entirely satisfactory.

FLOWRATES and CLARITY comparable to many grades of diatomite filteraids.

FILTERAID SAVINGS UP TO 20% because of Nerofil's lower cake density and high porosity.

READILY WETTABLE in either aqueous or non-aqueous solutions.

PHYSICALLY AND CHEMICALLY STABLE—Nerofil is unaffected by either acids or alkalis—tests show no silicon solubility in 50% sodium hydroxide at 125°F in 30 minutes.

FILTERCAKE IS COMBUSTIBLE, with a fuel value of 13,000 BTU per pound. Metals values recovery is thus easy, and disposal is no problem.

Excellent for Filler use, too

TREMENDOUS SURFACE AREA of Nerofil, plus its other properties, give it definite advantages as a filler in resins, cements, etc., as a catalyst carrier, in foundry applications and other uses.

USE COUPON FOR FREE ILLUSTRATED BULLETIN

NERO PRODUCTS DEPT., Great Lakes Carbon Corporation
333 No. Michigan Ave., Chicago 1, Ill.

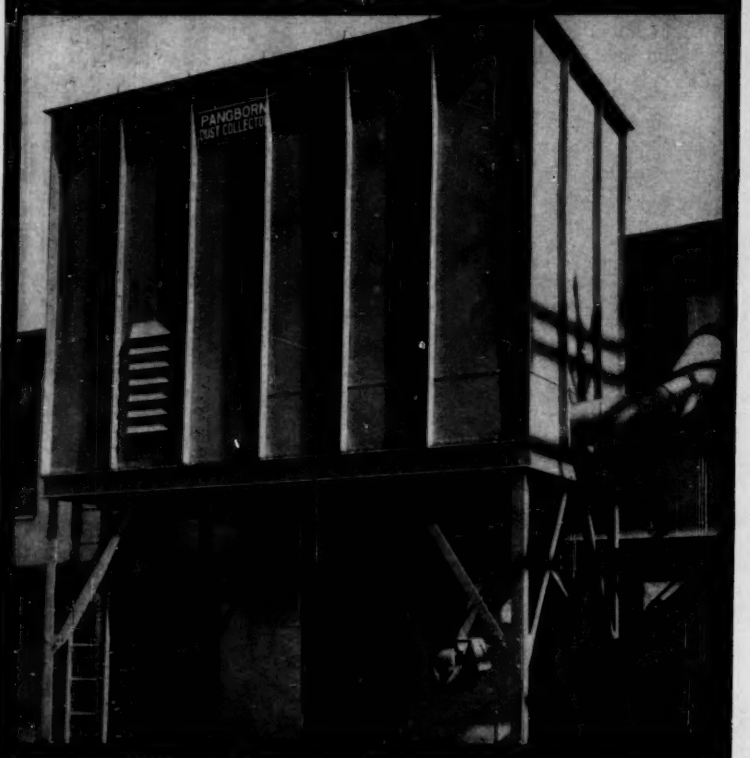
Yes, I'd like information on Nerofil for ☐ *Filtration* ☐ *Other Use*

Name_____ Position_____

Company_____

Address_____ City_____ Zone____ State_____

TRAPS ALMOST 4 CU. FT. OF DUST PER WEEK



One small Pangborn Dust Control system replaces 8 collector units profitably at Precision Rubber Products

At Precision Rubber Products Corporation, Dayton, Ohio, millions of seals pass through a buffing process every year. The resulting dust could constitute an operating and housekeeping hazard. To facilitate dust control, the company replaced eight individual collector units with a central Pangborn Dust Control system. This installation saves floor space, operates quietly and gives efficient dust control (trapping almost 4 cu. ft. of rubber dust per week). Dust is now removed from *one* collector hopper instead of eight individual hoppers.

If dust is a problem in your plant, talk to the Pangborn man in your area or write PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment—Rotoblast® Steel Shot and Grit.*

Pangborn CONTROLS DUST

ells.—**Aluminum Co. of America, Pittsburgh, Pa.** 205E

Tube fittings of the Swagelok line are available with Teflon resin as the material of construction. All shapes and sizes from ⅛- to 1-in. tubing are offered.—**Crawford Fitting, Cleveland, Ohio.** 206A

Pipe and tubing made of a new low-carbon, low-cobalt, low-boron stainless steel is available for use in nuclear applications. Welded, annealed and pickled, or drawn grades.—**Union Steel Corp., Union, N. J.** 206B

Control panels made of magnesium are easier and safer to alter in the field, company officials say. The new, lightweight panels can be faced on one or both sides with ⅛-in. sheet Formica or Mylar as required.—**Panellit, Inc., Skokie, Ill.** 206C

Plastic piping line of the manufacturer has been expanded to include a 3-in. PVC Y-globe valve, check valve, and strainer. Recommended service conditions are 150 psi. and 72 F.—**Walworth Co., New York, N. Y.** 206D

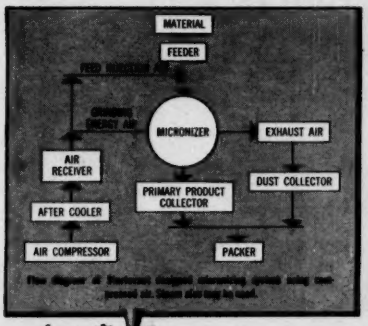
Equipment Cost Indexes . . .

	Sept. 1958	Dec. 1958
Industry		
Avg. of all	230.9	231.3
Process Industries		
Cement mfg.	223.3	223.7
Chemical	232.3	232.7
Clay products	217.0	217.4
Glass mfg.	219.3	219.7
Paint mfg.	222.8	223.1
Paper mfg.	223.8	224.2
Petroleum ind.	227.5	227.8
Rubber ind.	230.3	230.6
Process ind. avg.	228.6	228.8
Related Industries		
Elec. power equip	236.0	236.4
Mining, milling	233.7	234.1
Refrigerating	260.3	260.6
Steam power	218.1	218.4

Compiled quarterly by Marshall and Stevens, Inc., of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.

Need ½ to 44 Microns?

Sturtevant Micronizers* Make 325 Mesh Obsolete



One Operation Reduces, Classifies

Sturtevant Micronizers grind and classify in one operation in a single chamber—provide fines in range from ½ to 44 microns to meet today's increased product fineness needs. Can handle heat-sensitive materials.

Production Model (15 in. chamber)

No Attritional Heat

Particles in high speed rotation, propelled by compressed air entering shallow chamber at angles to periphery, grind each other by violent impact. Design gives instant accessibility, easy cleaning. No moving parts.

Classifying is Simultaneous

Centrifugal force keeps oversize material in grinding zone, cyclone action in central section of chamber classifies and collects fines for bagging. Rate of feed and pressure control particle size.

Eight Models Available

Grinding chambers range from 2 in. diameter laboratory size (½ to 1 lb. per hr. capacity) to large 36 in. diameter production size (500 to 4000 lbs. per hr. capacity). For full description, request Bulletin No. 091.

Engineered for Special Needs

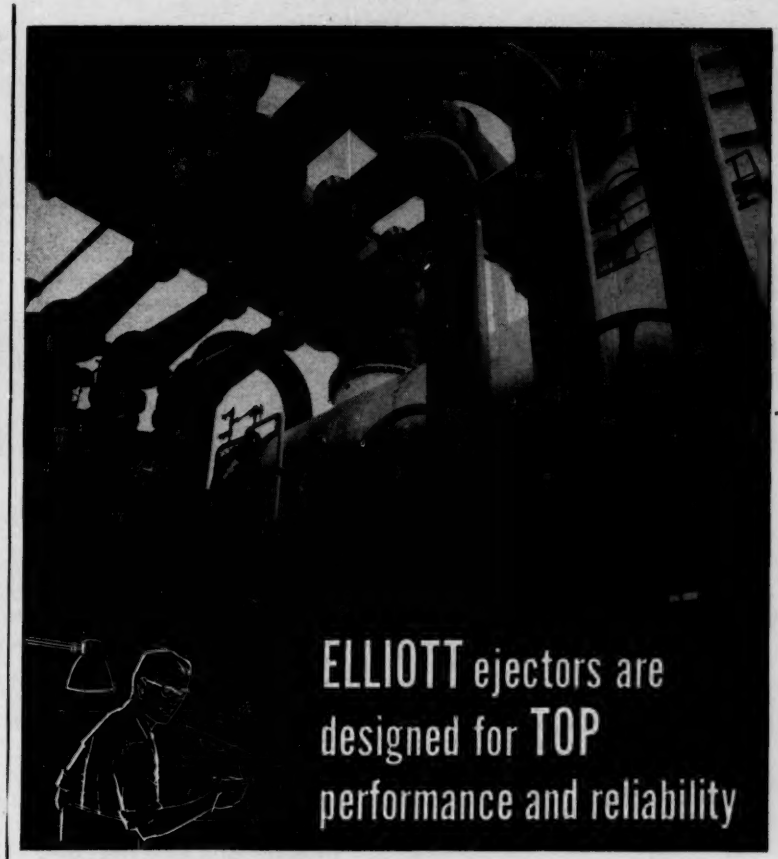
A 30 in. Sturtevant Micronizer is reducing titanium dioxide to under 1 micron at feed rate of 2250 lbs. per hr. For another firm, a 24 in. model grinds 50% DDT to 3.5 average microns at a solid feed rate of 1200-1400 lbs. per hr. A pharmaceutical house uses an 8 in. model to produce procaine-penicillin fines in the 5 to 20 micron range. Iron oxide pigment is being reduced by a 30 in. Micronizer to 2 to 3 average microns.

Sturtevant will help you plan a Fluid-Jet system for your ultra-fine grinding and classifying requirements. Write today.

Can Test or Contract Micronizing Help You?

Test micronizing of your own material, or production micronizing on contract basis, are part of Sturtevant service. See for yourself the improvement ultra-fine grinding can contribute to your product. Write for full details. STURTEVANT MILL CO., 180 Clayton St., Boston, Mass.

*REGISTERED TRADEMARK OF STURTEVANT MILL CO.



. . . *engineered and built to meet your requirements*

An unusual example of Elliott's engineering experience in designing and building steam jet ejectors and auxiliary equipment for producing vacuum is seen above. This photo shows the three first-stage ejectors of an Elliott triple element two-stage unit which serves a residuum stripper in a California oil refinery.

The vapor load from this vacuum flash unit adds up to approximately 57,000 lb per hr of steam, condensable hydrocarbon vapor and noncondensable gas. To handle this load efficiently and economically requires maintaining approximately 2 in. Hg absolute pressure *continuously*. Two Elliott 11,000-sq ft surface condensers are used, arranged in parallel, and the Elliott triple, two-stage ejector which serves these condensers is discharged to an intercondenser and an after-condenser combined in a common shell.

wide range of single-stage and multistage types

of Elliott steam jet ejectors is available for maintaining low absolute pressures in refineries, chemical plants and other processing industries. For complete data or engineering assistance, call the Elliott ejector specialist at your nearby Elliott District Office, or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

68-I

A great name
INTERNATIONAL
grows greater!

Through Expansion and Progressive Management, "INTERNATIONAL" has changed hands, to a new and more vital concept of usefulness to the entire Chemical field.

With new management, new capital and new manpower, "INTERNATIONAL" promises to bring a new measure of value to this highly respected name —with services expanded to cover a vast multitude of Mixing and Processing equipment, thoroughly modernized and definitely in step with today's demand.

We are changing the firm name, but you can be sure that "INTERNATIONAL" will continue to be your most important source of machinery and equipment designed to give you maximum VALUE, PERFORMANCE and ECONOMY!

LOOK TO INTERNATIONAL
If there is a better way —we can make it work

INTERNATIONAL PROCESS EQUIPMENT CO. INC.
1200 BOLANDER AVE. DAYTON 1, OHIO
15 PARK ROW NEW YORK

PEOPLE . . .

TECHNICAL BOOKSHELF

J. B. BACON

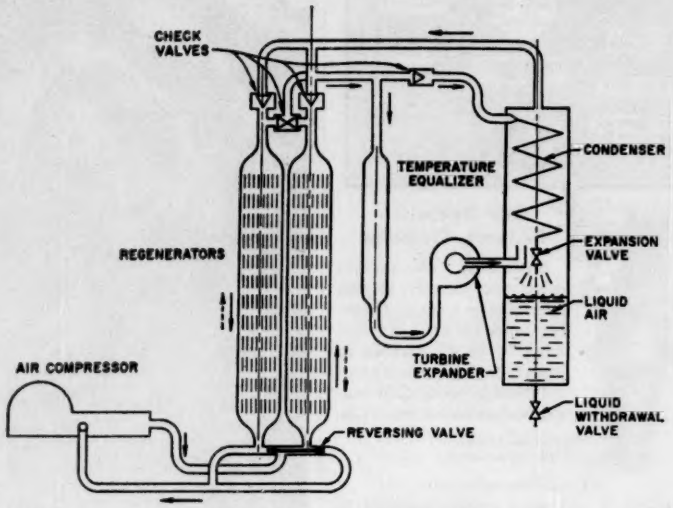


FIGURE 2.6. Kapitza air liquefier.

Illustrations like the one shown here pave a . . .

Clear Approach to Cryogenics

CRYOGENIC ENGINEERING. By Russell B. Scott. D. Van Nostrand Co., Inc., Princeton, N. J. 368 pages. $5.60.

Reviewed by G. H. Zenner, Engineering Laboratory, Linde Co., Tonawanda, N. Y.

This is the first book bearing the title of what is currently believed to be a relatively new and specialized field of engineering.

In connection with the missile or atomic energy programs, numerous scientists and engineers have found themselves confronted with unexpected problems in the production or handling of certain cryogenic (low-temperature) fluids, particularly liquid oxygen, nitrogen and hydrogen. Answers to their questions were not to be found in the meager available literature. This new publication is therefore directed primarily to aid such new entrants in the field.

The production and handling of cryogenic fluids is, however, an old art and the separation of oxygen and nitrogen from air by liquefaction and distillation is a widely established commercial cryogenic process. Engineers in this industry have long been familiar with the special conditions in their field.

Production and handling of liquid hydrogen and liquid helium receive rather extensive treatment by the author. Interest in these fluids in commercial quantities is rather high at present and in this area, particularly, the book is timely.

The author discusses at some length those subjects with which he is most familiar, particularly the work done at the Cryogenic Engineering Laboratories of the National Bureau of Standards

in Boulder, Colo. Certain auxiliary subjects, for example, Low Temperature Thermometry, are treated in considerable detail. Such curiosities as the Ranque (or Hilsch) Vortex Tube or the Roebuck device are clearly and briefly described, although they are of little significance.

However, no mention is made of such important cryogenic fluids as liquid methane or liquid fluorine. Neither is there any appreciable review of the specialized cryogenic equipment developed for missiles. Equipment for the production and distribution of such an important cryogenic fluid as liquid oxygen is only briefly outlined. Much of the book is concerned with laboratory operations rather than industrial practice. In several cases, subjects are discussed because published information is available whereas the engineering importance may be relatively insignificant.

The book is exceptionally well written. A subject such as the ideal work to produce a cryogenic liquid could readily be presented so as to be confusing to the average engineer. Instead, it is presented clearly, briefly, and accurately. Numerous illustrations and pictures aid the lucidity of the discussion.

The book should be well received by those who are new to the field. And, although it is sketchy in its treatment of commercial cryogenic processes, the book should also be of interest to those who are familiar with this field.

Provides New Insight

PRECIPITATION FROM HOMOGENEOUS SOLUTION. By Louis Gordon, Murrell L. Saletsky and Hobart H. Willard. John Wiley & Sons, Inc., New York. 187 pages. $7.50.

Reviewed by John M. Dunham, Sterling-Winthrop Research Institute, Rensselaer, N. Y.

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remained for Willard and Tang to demonstrate that dense, easily filtered precipitates having minimal coprecipitation could be obtained under controlled conditions by precipitation from homogeneous solution.

They precipitated aluminum hydroxide by heating an acidic solution of aluminum containing urea. The hydrolysis of urea liberated the precipitant ammonia by a homogeneous chemical reaction. The formation of the dense precipitate was dependant upon both a slow increase in pH and, equally important, the presence of the proper anion.

The present volume contains a balanced discussion of the current status in this field.

Following a brief introduction are six chapters summarizing and classifying information under the precipitant formed in solution. The detailed laboratory procedures can be used without recourse to the original literature. There follow chapters on coprecipitation, fractional precipitation and a final chapter entitled Applications in Chemical Technology.

The chemical engineer who is using precipitation techniques will gain new insight into more efficient operations by reading these final chapters.

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NITROGEN. *Published quarterly by British Sulphur Corp., Ltd., Fison House, 95, Wigmore St., London, W. 1, England.* Price in England: 10 guineas (£10.10s. 0d.). New magazine will report technical and economic developments affecting production and consumption of nitrogen and its derivatives throughout the world.

EVAPORATIVE COOLING OF CIRCULATING WATER (ISPARITEL'NOE OKHLAZDENIE TSIRKULYATSIONNOI VODY) *2nd revised ed.* 398 *pp. By L. D. Berman. Pergamon Institute, 122 E. 55 St., New York; 4 & 5 Fitzroy Sq., London, W. 1, England.* Institute is asking for initial guarantees of $300 towards cost of translation and reproduction, cost to be reduced if number of subscribers exceeds ten. Work gives fundamentals of cooling and theory, design and operation of coolers.

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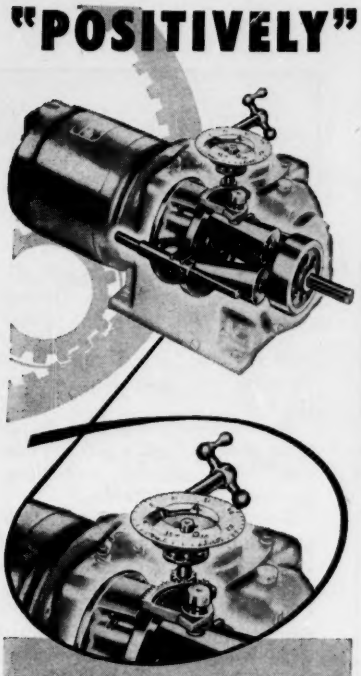

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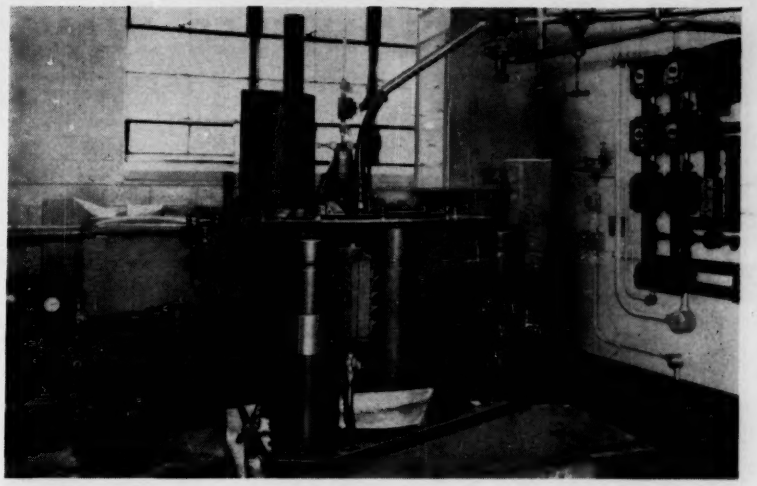

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LETTERS:

The Job of Job-Hunting

Sir:

I was very much interested in your article, "Job Signals Point Upward," in your May 4 issue (p. 152).

It would certainly be a change to be able to "get a job the easy way." My personal experience has been quite different.

I was job hunting in 1948-52 and am now doing it again. With 12-16 years' experience then and with 23 years' experience now, I get the same impression. It is almost impossible to get in touch with prospective employers except through personal contacts, and even that requires the luck to be on the right spot at the right time. Prospective employers of experienced engineers do not seem to advertise the kind of jobs they would expect me to fill, so there is no point of worthwhile contact.

A. S. PARKER

Wayne, Pa.

Pro: Better Filing

Sir:

I noted with interest your editorial reply to one of your correspondents in the June 1 issue (pp. 164-165).

As chairman of the AIChE Standards Committee I can assure you that our subcommittee, under the chairmanship of Charles M. Cooper of Du Pont, Wilmington, is not letting this project die a-borning. His committee has been assembled and is actively engaged in surveying the information available, with a view to determining the need for a standard information classification system in the chemical engineering profession, as well as the chemical industry.

The Standards Committee, as well as the subcommittee chairman, have received a goodly number of communications from interested parties indicating a considerable interest. It is hoped that the subcommittee will make

PRO & CON

C. H. CHILTON

its recommendations to the parent committee without too much delay so that the matter may be disposed of one way or the other at an early date.

Interested chemical engineers may communicate directly with Mr. Cooper.

JAMES C. LAWRENCE
Moylan, Pa.

AIChE on Registration

Sir:

You will be interested in the recent action of AIChE Council in approving a statement on registration policy. Essentially, this is the work of a special committee headed by Jerry McAfee, this year's vice president of the institute.

We have had many requests for the specific statement, and additional copies are available on request.

F. J. VAN ANTWERPEN
American Institute of Chemical Engineers
New York, N. Y.

▶ *Earlier this year we asked AIChE for a policy statement to answer the questions posed in a letter from F. E. Reese (Apr. 6, pp. 191-193). Because of its fundamental importance to all professionally minded chemical engineers, we publish this statement in full below.*—ED.

AICHE COUNCIL STATEMENT ON REGISTRATION

Professional responsibility for engineering work is a personal responsibility and is based on adequate training, experience, intellectual capacity and moral integrity. Registration is not a substitute for it. Because many

Your comments and opinions are important. Send them to Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y. They'll be welcomed.

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slimes cannot remix with sands
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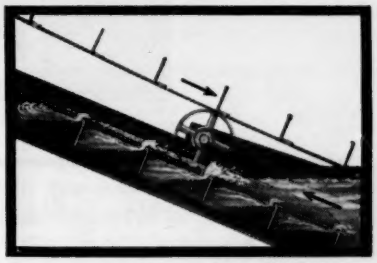

Section through "Overdrain" Classifier showing upward-moving, closed, washing compartments.

The only outlet from these compartments is via holes in the belt above. Surplus liquid and slimes discharge through these "overdrain" holes without mixing with the oncoming sands. The end result is an extremely clean sand discharge, excellent de-sliming—making the "Overdrain" Classifier an ideal washing device.

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Unretouched photograph of "Overdrain" action above the belt—water and slimes discharging upwardly.

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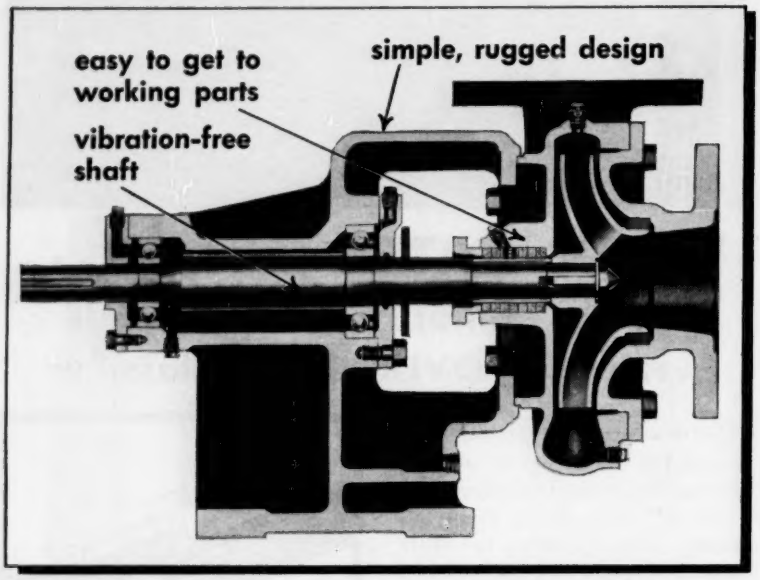

● Note, in the cut-a-way illustration above, the simplified, yet sturdy design of Weinman single-stage, end-suction pumps. The key to their low initial cost and efficient operation with little or no maintenance is the rugged, one-piece power frame combined with a neat, shipshape working head. This assures plenty of pumping power and long, trouble-free service.

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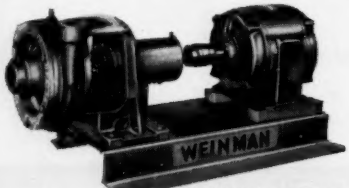

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of the factors which characterize a truly professional person cannot be measured quantitatively, the inherent personal nature of professional responsibility should be recognized in all laws relating to the registration and licensing of engineers.

Although the AIChE does not believe that registration of itself contributes significantly to professional responsibility and professional development, it recognizes that in some cases, registration is considered to be one mark of public recognition of professional status. The AIChE takes the position that registration should be accorded no greater importance than is placed on other indications of professional status, such as academic degrees, membership in professional organizations, technical publications, and advancement in industrial, academic and governmental careers.

The AIChE is not in favor of compulsory registration of all engineers. It recognizes, however, that all states have now enacted engineering registration laws, and it is possible that any engineer in the course of his career may wish to become engaged in activities requiring registration. Therefore, the AIChE recommends that its members should, as a practical expedient, become registered in their respective states as soon as possible after entering the profession.

Believing that individual professional responsibility is the only adequate safeguard of the public interest and that the size and nature of an engineering organization is not a criterion of such professional responsibility, the AIChE feels that there should be no discrimination by implication, omission or direction as to the form of business organization (individual, partnership, corporation or other) through which the professional services of engineers can properly be offered. Laws regulating the public practice of engineering, while they may require the registration of the engineer or engineers in responsible charge of a project, should not require the *ex officio* registration of corporate officers, directors or others.

JUST BETWEEN US...

Dear Readers:

About 18 months ago we introduced to you a new assistant editor, Thomas H. Arnold, Jr. Now we are happy to tell you of Tom's forthcoming promotion and of the new job he will be starting soon after you read this notice.

In 1950 James A. Lee—known personally to many of you, especially in the South—transferred from New York to Houston as our Southwestern Editor. Jim will soon retire, and Tom has joined him to spend a few weeks learning the ropes before we bid farewell to Jim on September 1. From that date, Tom will be our Southwestern Editor—also representing our sister publication, *Chemical Week*, in like capacity.

Like Jim, Tom is a Southerner. He earned his B.S. in chemical engineering at Louisiana State University in 1951. In 1954 he took his M.S. at the same school and more recently spent another graduate year there, minoring in petroleum engineering. Before he entered the Army Chemical Corps in 1954 he gained experience in refining and petrochemicals with Esso and Ethyl Corp. in Baton Rouge. At one time he was assistant to a consulting chemical engineer in the sugar field. He also worked on process development for Niagara Chemical Div. of Food Machinery & Chemical Corp.

In his new assignment, Tom's beat will be the chemical process industries of the South and Southwest. He'll be digging both for news and for feature article material. You have already benefited from the highly perceptive editing job Tom did here while in our New York headquarters. We predict you will benefit even more from this new phase of his editorial activity. He will be covering industries and area that he knows and loves.

T. R. OLIVE
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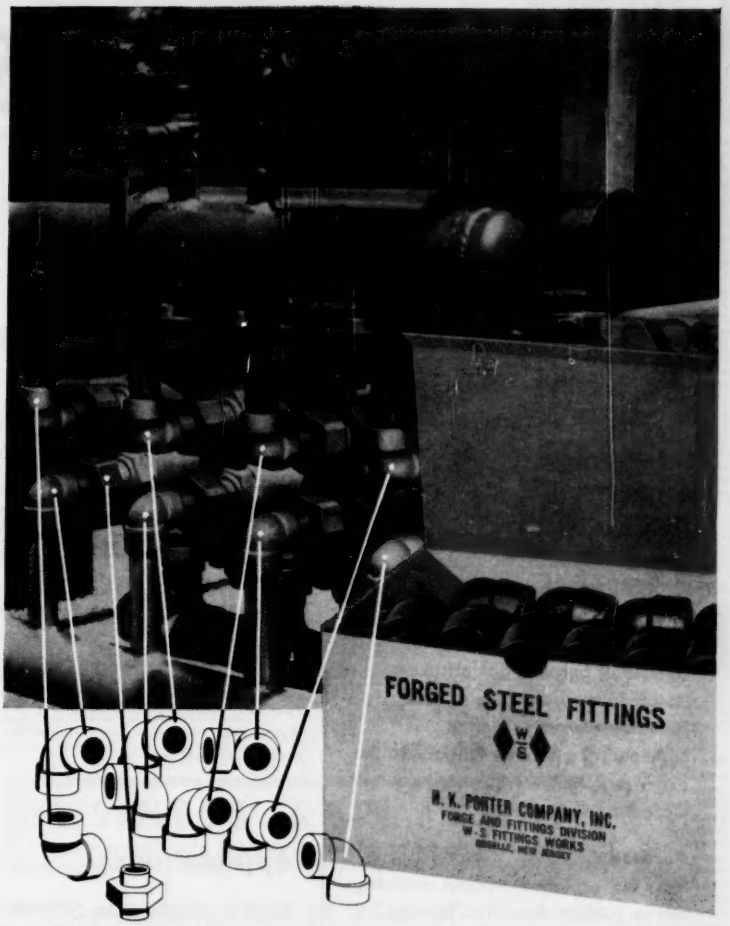

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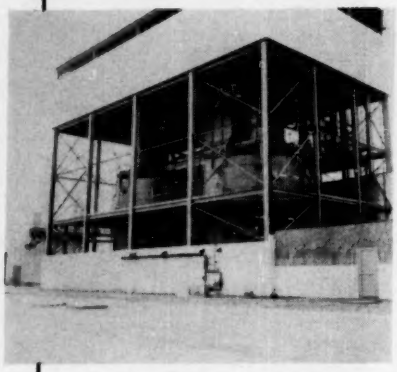

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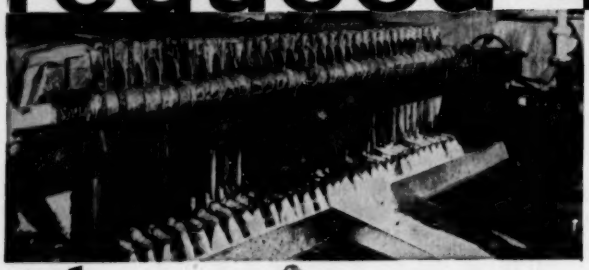

at ANACONDA® with NETONE FILTER PAPER

- *Netone has service life of 12 cycles (old paper lasted one cycle)*
- *Easier to put on filter press, less installation damage*
- *Shows excellent resistance to solution shock*

At The Anaconda Company, Electrolytic Zinc Plant, located at Anaconda, Montana, Netone filter paper has been used exclusively on the Shriver filter presses since January 1, 1955. Netone is a heavy, neoprene filled paper possessing remarkable wet strength characteristics.

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Annual filter paper costs have been reduced 41%. The savings in labor and filter down time are also considerable.

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Chemicals

Adhesives.....A new carboxylated polyvinyl acetate copolymer resin primarily for use in formulating paper adhesives is described in 2 p. data sheet 4212.
220A Shawinigan Resins Corp.

Aerosol.....Ethyl alcohol and polyethylene have played an important role in the steady growth of the aerosol industry. Production figures 20% above 1957.
33-34a *U. S. Industrial Chemical Co.

Aromatic Solvents.....Solvesso offers advanced refining techniques, the latest quality improvements & high performance characteristics. Information & technical assistance.
12 *Esso Standard Oil Co.

Boron.....4 p. bulletin provides a complete listing of physical properties of 17 chemicals common to boron chemistry and related fields. Suggests uses for the chemicals.
220B Callery Chemical Co.

Carbon Dioxide.....CO_2 has a high vapor pressure at all times. It does not require metering of fuel and is uniformly pure at all times. Full details on this inert gas.
196 *Olin Mathieson Corp.

Catalysts.....are available in 6 forms: tableted, extruded, granular, spheres, flakes & powders. Performed catalysts to fit special process requirements.
6 *The Harshaw Chemical Co.

Chemicals.....The 1959 Physical Properties of Synthetic Organic Chemicals—a comprehensive description of the properties & applications of more than 400 chemicals.
167 *Union Carbide Chemicals Co.

Diatomaceous Earth.....4 p. bulletin gives complete technical data and properties of company's earth. Describes such uses as insecticide and high fertilizer conditioning.
220C Aquafil Co.

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Elastomer.....Fluorel is highly resistant to corrosive fume & many fluids even when they're blistering hot. It is easy to process & mold. Complete data offered.
16-17 *Minnesota Mining & Mfg. Co.

Filteraid.....Nerofil, carbon-based filteraid for difficult filtrations such as caustic or fluorated solutions. Available in 6 grades. An illustrated bulletin is offered.
205 *Great Lakes Carbon Corp.

Furfural.....for product development or process improvement. Bulletin No. 203-A contains physical data on furfural. Now available on request.
91 *Quaker Oats Co., Chem. Div.

Lithium Chemicals.....12 p. booklet gives specifications for products ordinarily available from inventory stocks. Includes lithium, electromanganese, zirconium, nickel.
221A Foote Mineral Co.

Lubricants.....Book discusses organized lubrication from management's point of view. Also discusses methods that help raise production, extend parts life, cut downtime.
173 *Texaco, Inc.

Lubrication.....Bulletin "lubrication of Roller and Silent Chain Drives" covers principles of lubrication, maintenance and oil selection. Oil selection charts included.
221B Sun Oil Co.

Methionine.....in the body, when converted to adenosylmethionine, can participate in epinephrine synthesis; react with niacin; enter the brain; help form spermine, etc.
33-34e *U.S. Industrial Chemicals Co.

Molybdenum.....Molybdenum's contribution to uniform strength in gray iron castings is detailed in a new bulletin No. 8 called "Moly Iron castings."
221C Climax Molybdenum Co.

Oils, White.....Technical Data File F-42 describes special white mineral oils for the plastics industry. Oils can serve as plasticizers, extenders, softeners, lubricants.
221D L. Sonneborn Sons, Inc.

* From advertisement, this issue

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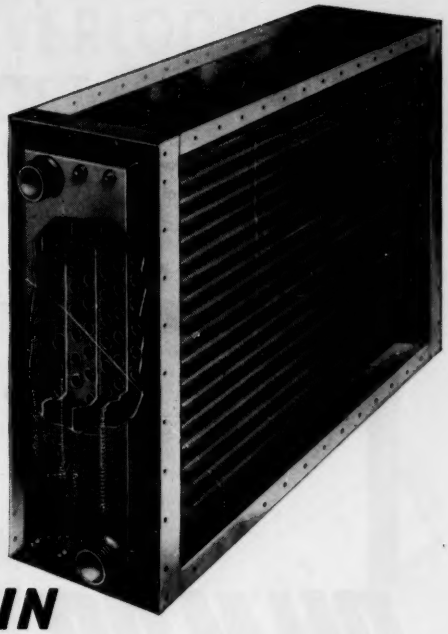

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- Complete Drainability
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Completely drainable and easily cleaned, Aerofin Type "R" coils are specially designed for installations where frequent mechanical cleaning of the inside of the tubes is required.

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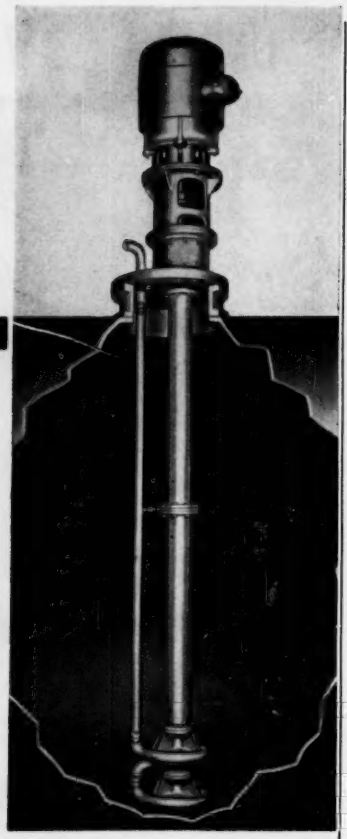

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PUMPS to handle LIQUID CHLORINE

Pumping liquid chlorine calls for more ingenuity and engineering skill than is available from the average pump manufacturer. Formerly it was pumped pneumatically. This method was attended by a considerable loss of chlorine because the moisture in the air formed hydrochloric acid. A further complication was the corrosive action of the acid vapors.

To overcome this, Lawrence engineers in collaboration with manufacturers of chlorine, developed a pump with a special packing box which prevents any contamination of the chlorine or corrosion of any of the equipment and also prevents the escape of the chlorine fumes to the atmosphere.

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Send for Bulletin 203-7 for a complete summary of acid and chemical pump data.

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LITERATURE . . .

Olefins.....Complete information on specifications & characteristics of Tetrapropylene & Tripropylene & many other high quality petrochemicals is available.
75 *Enjay Company, Inc.

Plastics, Reinforced.....28 p. Catalog P-11 describes the wide range of applications of Haveg polyester-glass industrial corrosion-resistant equipment.
222A Haveg Industries, Inc.

Polyesters.....10 p. technical report N-106 covers work in the catalytic reaction of neopentyl glycol with dibasic acids to form hydroxy terminated polyesters.
222B Eastman Chemical Products

Polyester Resins.....4 p. bulletin describes new chemical- and corrosion-resistant resin Uraloy 7416 said to combine handling ease & moderate cost.
222C Interchemical Corp.

Polyethylene.....New compound now in the process development stage has been made available to polyethylene manufacturers for evaluation as an ultraviolet absorber.
33-34c *U.S. Industrial Chemicals Co.

PVAc Emulsion.....1 p. data sheet 1210-M describes properties, uses and performance of a new fine particle polyvinyl acetate homopolymer emulsion.
222D Shawinigan Resins Corp.

Rubbers, Synthetic.....16 p. data and specification book covers a line of masterbatch synthetic rubbers. Points out four ways by which rubber processors may save on costs.
222E Goodrich-Gulf Chemicals, Inc.

Sodium Borohydride.....SWS is a stable, aqueous caustic solution of sodium borohydride. It is easy & safe to handle & use in standard equipment. Complete information.
97 *Metal Hydrides Inc.

Construction Materials

Aluminum Bus Conductor.....features low material cost, low installation & maintenance costs. Complete information in Handbook which is offered.
79 *Aluminum Co. of America

Blanket Insulation.....Complete information on B-H Blanket Insulation is contained in catalog. Contract application service is available in 48 states.
114 *Baldwin-Hill Company

Cadmium, Lead and Tin.....Many new uses for cadmium, lead and tin in diversified industries and crafts are explored in a new bulletin. Rolling and extrusion data.
222F White Metal Rolling

Coatings.....Amercoat No. 78 offers dependable, all-around protection. Illustrated copies of comparative tests of Coal Tar Epoxy Coatings is now available.
185 *Amercoat Corporation

Coatings.....Brochure LEC-1 contains a full description of each coating including specifications, application data, baking instructions & suggestions & related data.
200 *Lining Engineering Corp.

* From advertisement, this issue

LITERATURE . . .

Construction Material.....Glasteel 59 gives 150F. thermal shock protection at a peak operating vessel temp. of 450F. Offers excellent acid & alkali resistance. Bul. 980.
30-31a *Pfaudler Permutit Inc.

Diatomite.....Celite has the exact grade for every filtration need from fast flow rate to maximum clarity. Information on specific filtration problems.
161 *Johns-Manville

Flooring Materials.....4 p. Bulletin 659 describes paving, patching, and grouting materials and brick, all emery-based, and bonding and curing agents made by company.
223A Walter Maguire Co.

Fused Quartz.....Vitreosil is available in an unusually wide variety of types & sizes. Offers outstanding electrical properties. Tech. Data.
*Thermal American Fused Quartz
R233

Gaskets.....Booklet full describes "Armalon" felts . . . a new class of gasket materials developed for severe services. Information on sizes & thicknesses, etc.
129 *E. I. du Pont de Nemours & Co.

Grating & Treads.....Bulletin No. 2527 contains detailed information on Electroforged steel grating & treads for your needs. Self-cleaning, designed for flexibility.
163 *Blaw-Knox Co.

Industrial Coatings.....Insul-Matic 553 can be spray-applied in one continuous, uniform coating to metal, masonry or ceramic surfaces. Information.
171 *Pittsburgh Coke & Chem. Co.

Insulation.....Snap-On is one-piece insulation molded of fine glass fibers. It is flexible & has a resilient toughness. Information available on request.
195 *Gustin-Bacon Mfg. Co.

Insulation.....Foamglas is completely moisture-proof to insure constant high insulating value for the life of tanks. A complete line of mastics, tank coatings, etc. Details.
64 *Pittsburgh Corning Corp.

Linings, Plastic.....Fluorocarbon linings are impervious to all the most difficult acids, alkalies & other highly corrosive chemicals. Details in Bulletin AD-152.
193 *U.S Gasket Company

Plastic.....Epon 828 is used in the manufacture of many products, such as boats, tools & dies, aircraft, commercial adhesives, & vinyl stabilizers. Information.
Cover *Shell Chemical Corp.

Protective Coating.....1 p. Report No. 307 describes a transparent liquid waterproofing for application on unpainted exterior masonry and stone surfaces.
223B United Laboratories, Inc.

Refractories.....There is a wide range of products, each with a combination of properties. A copy of "Super Refractories by Carborundum" is now available.
120 *The Carborundum Co.

Refractories.....The complete range of castable refractories, a number of which are in reality specialized for use in certain parts of sodium silicate & glass furnaces.
28-29 *Harbison-Walker

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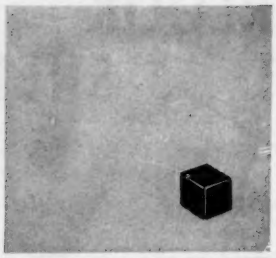

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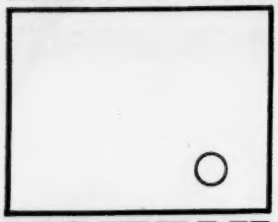

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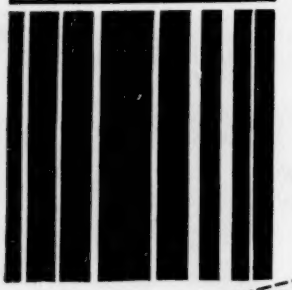
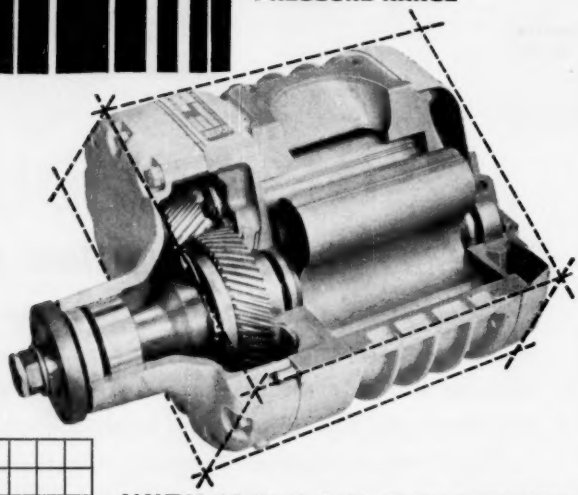
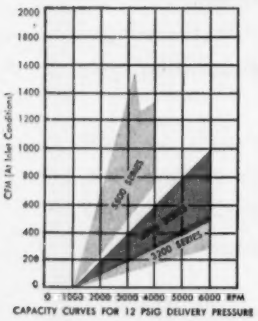


WIDEST PRESSURE RANGE





WITH M-D 3-LOBE BLOWERS

If space and weight of the blower is a concern in your design problem, consider this fact. M-D rotary positive blowers because of their unique 3-lobe design require smaller cubic space than any other blowers. A survey shows that a 14 PSI M-D takes 3/4 to less than 1/10 the space of competitive models . . . and in some cases are only 1/10 the weight.

M-D Blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 11 production models range from 50 to 4000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.

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M-D BLOWERS, INC., RACINE, WISCONSIN

A Subsidiary of Miehle-Goss-Dexter, Inc.

MD

LITERATURE . . .

Stainless Steel.....Information on 18-12 Mo ELC Stainless (Type 316L) is available. Its superior corrosion resistance less maintenance & year of dependable service.
112 *Armco Steel Corporation

Steel.....“300-M Ultra High Strength Steel” is the title of a booklet; gives charts and tables based on extensive tests on 300-M steel. Offered without charge.
224A International Nickel

Titanium.....for highly corrosive service. Information, “Cost Cutting Ideas in Titanium for Chemical Pumps, Valves & Accessories”, is available on request.
169 *Mallory-Sharon Metals Corp.

Urethane Coatings.....Technical Service Bulletin TS-4 covers one-can urethane coatings. Tests show they have better gloss retention, and mildew resistance.
224B National Aniline Div.

Zinc Dust.....used as a reducing agent, precipitating agent, purifier, catalyst, polymerizing agent, in rust-resistant paints, bleaches, etc.
*American Smelting & Refining Co.
199

Electrical & Mechanical

BH Drive.....drastically reduces drive maintenance with these features: fast pilot fit alignment every time, longer-lasting shaft & seal, etc. Bul. No. 972.
30-31e *Pfaudler Permutit Inc.

Boiler Inspection Light.....An explosion-proof light and view port, designed so that operators can observe the space between boiler casings, is described in data sheet.
224C Robert H. Wager Co.

Casters & Wheels.....Feature rubber treads, rust-proofed, string guards, and lubrication. A manual outlining all features in detail is now available.
R227 *Darnell Corp. Ltd.

Drive.....New Allispede drive can be supplied with in-line or right-angle integral gears, brake & tachometer. Sizes from 1 to 20HP with speed variations to 8:1. Bul. 3300.
59 *The Louis Allis Co.

Drives.....All steel shaft mounted with hp range ½ to 50 np., output speed range 420 to 5 rpm. Torque ratings up to 41,000 lb-in. Information in Bulletin 7100.
113a *The Falk Corp.

Electrical Connectors.....Bulletin describes complete line of plugs and receptacles for moisture-, shock-, dust- and corrosion-resisting applications. To 225 F.
224D Crouse-Hinds Co.

Electrical Connectors.....Illustrated catalog describes a line of electrical connectors. All styles covered. Lists electrical current ratings for cable. Cat. B-73.
224E Joy Mfg. Co.

High-Voltage Starters.....Starters for squirrel cage, wound rotor and synchronous motors, in both air- and oil-bread forms are described in a new eight-page bulletin.
224F Electric Controller & Mfg.

* From advertisement, this issue

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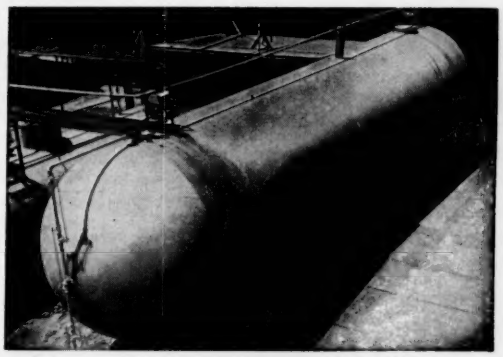

• We have been supplying the chemical processing industry with tanks and vessels for chemical storage for three generations. In addition to carbon and stainless steel, we also fabricate and erect tanks, pressure vessels and processing equipment of aluminum and special alloys. . . . Investigate our facilities and take advantage of our 103 years of specialized knowledge and experience. . . . Write for *Tank Talks.*

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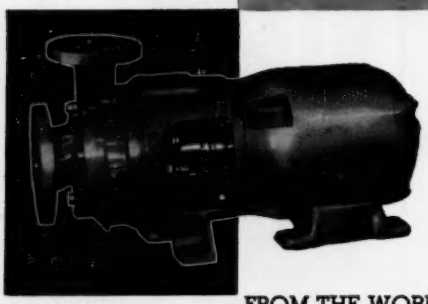
Designers and Manufacturers of
Ball, Pebble and Jar Mills • Pulverizers
Sifters • Cutters • Mixers

better pump design cuts operating costs



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From ¼ to 75 horsepower

FROM THE WORLD'S LARGEST manufacturer of centrifugal pumps, modern Motorpumps come to you with time-tested features that assure continuous, year-after-year savings.

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Immersion type Motorpump

Complete specifications and performance data are available at your request.

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9-822

11 Broadway, New York 4, N.Y.

LITERATURE . . .

Joint.....The new Sola-Flex unique solid-ring-supported joint withstands pressures to 1200 psi. Additional information on how Sola-Flex joints can serve you.
52 *Solar Aircraft Company

Mercury Switches.....Revised catalog 90b describes a standard line of mercury switches. Included are photograph, dimensions, ratings and application information.
226A Micro Switch

Motor Control.....A complete line of low voltage control (size 0 through 8) & high voltage control in all NEMA enclosures, plus engineered control systems. Details.
109 *Allis-Chalmers, Gen. Prod. Div.

Motoreducers.....available in horizontal, vertical & right angle types. Units are available up to 75 hp; output speeds from 780 rpm down to 1.2 rpm. Bul. 3100.
113b *The Falk Corp.

Motor Starter & Circuit Breaker..... now available in 7″ & 9″ sizes for sizes 1 & 2 starter combinations. Detailed information on the many special features.
68 *Crouse-Hinds

Switches.....Sealed "Plug-in Limit" switches are now available in 8 actuator types. Catalog 84 gives details of the "200LS" series. Can be replaced in 20 seconds.
58 *Minneapolis-Honeywell

Thermocouple Wire.....Sub-zero Ceramo-Couple solves condensation problems. Liquid oxygen, nitrogen, ammonia and similar applications. Bul. 52-E.
B247 *Thermo Electric Co., Inc.

Turbines.....A complete range of power-packed turbines, from 1 HP to 250 HP. Built to customer specifications. Further facts on turbines in new Catalog 200.
45 *Coppus Engineering Corp.

Turbines.....are available in flow ranges from as low as 20 scfm to over 1500 scfm. Information on turbo-expanders and industrial compressors available.
L236 *Stratos Industrial Products

Variable Speed Drive.....Features unlimited speed range, true compactness, & automated speed control. Catalog outlining other features is now available.
L211 *Graham Transmissions, Inc.

Vertical Battery Chargers.....Compact vertically mounted, motor-generator battery chargers that save up to two-thirds floor space are the topic of new bulletin.
226B Exide Industrial

Handling & Packaging

Automatic Bag Closer.....Model BA-6 sews at rate of 30 feet per minute. Details & complete catalog-file of bag closing equipment are available.
T246 *Dave Fischbein Co.

Conveyor, Pneumatic.....Bul. I-28 tells how to select, operate & maintain systems for transporting dry, bulk materials. Positive, negative & combination systems described.
127b *Sprout-Waldron & Co., Inc.

* From advertisement, this issue

When the design calls for an indicating gauge, specify the best—
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New catalog covers gauges for every need
MARSH INSTRUMENT CO.
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For the final dispersion of detergent, bleach, perfume and highly abrasive silica flour in a popular powdered household detergent, this 27" model with abrasion resistant impactors does the job.

Free test runs on your material.

Send for literature on Impact Milling, Particle Size Reduction and the new line of Vibrating Screens.

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DIVISION OF SAFETY INDUSTRIES, INC.
P. O. Box 904, New Haven, Conn.

IT PAYS TO SPECIFY

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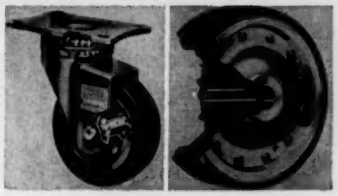
CASTERS AND WHEELS



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1. **RUBBER TREADS** . . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.

2. **RUST-PROOFED** . . . by zinc plating, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

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4. **LUBRICATION** . . . all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.

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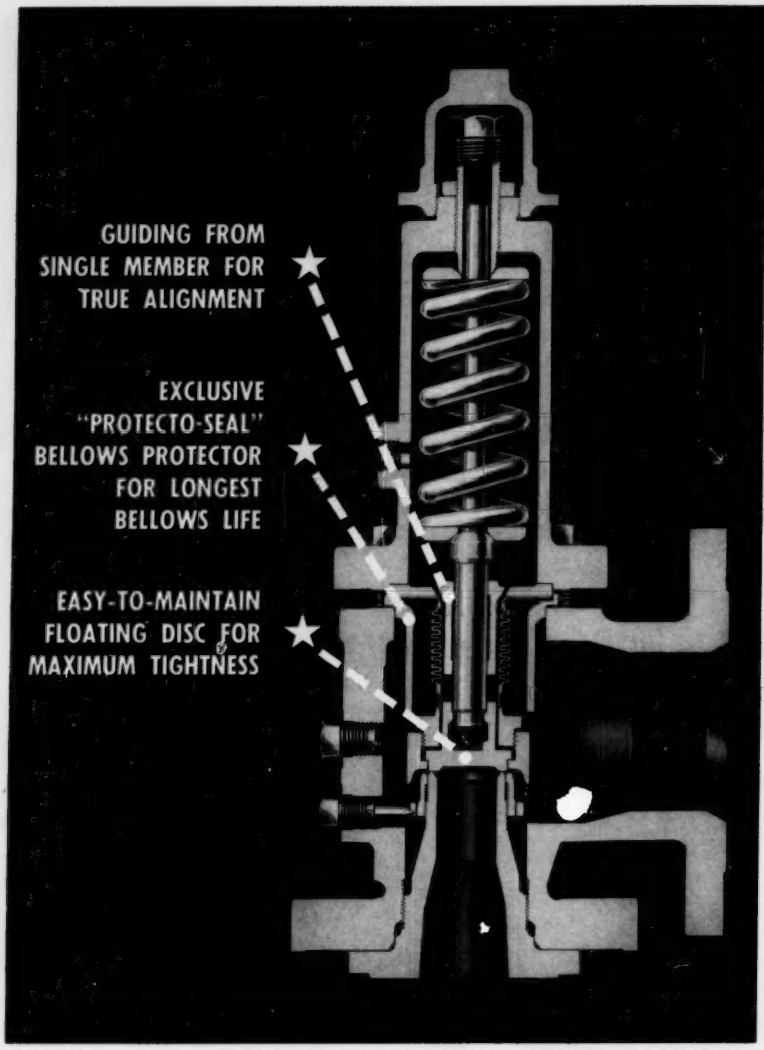
36 NORTH CLINTON STREET CHICAGO 6 ILLINOIS


GUIDING FROM SINGLE MEMBER FOR TRUE ALIGNMENT
EXCLUSIVE "PROTECTO-SEAL" BELLOWS PROTECTOR FOR LONGEST BELLOWS LIFE
EASY-TO-MAINTAIN FLOATING DISC FOR MAXIMUM TIGHTNESS

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Maximum protection against corrosion or fouling of working parts and variable back pressure surges.

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LITERATURE . . .

Conveyors.....Air-Float conveyors provide trouble-free air-gravity conveying of dry materials. High capacity . . . operate quietly . . . require little headroom. Details.
40b *Kennedy Van Saun Mfg.

Cooler & Dryer, Pellet.....The industrial Rotaircool for drying & pneumatic conveying of pellets. Has major redesign features. Complete details in Bulletin 202.
127a *Sprout-Waldron & Co., Inc.

Electronic Weighing.....Booklet explains the history and development of electronic weighing, theory of operation, instrumentation, economic considerations, data.
228A Streeter-Amet Co.

Loading Arms.....deal with hard-to-handle corrosive chemicals, hydrocarbons & other fluids & gases in all kinds of weather. Descriptive literature.
37 *Chiksan Co.

Pneumatic Conveying System.....The Airveyor system is easily installed & automatically controlled. Features self-cleaning facility. Complete details available.
56 *Fuller Company

Portable Platform Scale.....reads quickly & clearly, moves easily through narrower aisles and stays accurate & sensitive under roughest conditions. Model 1124-A. Cat.
189 *Fairbanks-Morse & Co.

Tanks.....of carbon & stainless steel for chemical storage. Also pressure vessels & processing equip. of aluminum & special alloys. Booklet "Tank Talks" is offered.
BL225 *R. D. Cole Mfg. Co.

Tractor Shovel.....with a carry capacity of 2500-lb. Feature rugged, simplified design, sealed brakes & electrical system, protected steering linkage, etc. Full data.
18-19 *The Yale & Towne Mfg. Co.

Vibratory Feeder.....Provides accurate, uniform rate of feed of bulk material . . . variable from ounces to tons. New glass fiber springs reduce breakage. Fact File.
R231 *Eriez Mfg. Company

Weigh Feeder.....Electronically controlled weigh feeder machines deliver accurate amounts of dry bulk materials. Illustrated literature gives full details.
228B Syntron Co.

Weigher-Feeder.....is designed to handle such instrument-controlled functions as flow totalizing, recording, programming & material proportioning. Catalog 12.
194 *Weighing & Control Components

Heating & Cooling

Coils.....Type "R" coils are specially designed for installations where frequent mechanical cleaning of the inside of the tubes is required. Bulletin R-50.
221 *Aerofin Corporation

Control Instruments.....A complete catalog on Capacitance Instruments is offered. Information on Level-Tel, Level-Tek, Level-Set and Level-Log instruments.
159 *Robertshaw-Fulton Controls Co.

* From advertisement, this issue

Heaters.....Tantalum bayonet heaters are completely corrosion resistant for practically all chemical processing applications. Details in Bulletin No. 978.
30-31d *Pfaudler Permutit Inc.

Heaters, Cartridge.....Diameters from ⅜ to 1 1/32 inches, lengths from 1⅝ to 25⅜ inches. Special leads available for protection against flexing action, abrasion, etc.
186c *Edwin L. Wiegand Co.

Heaters, Electric.....are available in sheath materials & wattages to match almost any application to 1100 F. New Catalog 60 provides detailed product information.
186a *Edwin L. Wiegand Co.

Heaters, Strip.....Lengths from 4 to 96", widths from ¾ to 2½", with cross section curving or lengthwise bending. Available with brazed-on fins. Catalog 60.
186d *Edwin L. Wiegand Co.

Heaters, Tubular.....Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Catalog 60.
186b *Edwin L. Wiegand Co.

Preheater, Air.....Factual information on Ljungstrom Air Preheater is contained in a reprint of a published magazine article which is available on request.
35 *The Air Preheater Corp.

Pressure Vessels & Heat Exchangers.....Bulletins HE and CI outline the craftsmanship in the design & fabrication of pressure vessels & heat exchangers.
13 *Downington Iron Works, Inc.

Steam Jet Heaters.....utilize the jet principle to mix steam with a cold liquid, uniformly & kithout noise & vibration. Complete details on all types in Bulletin 3A.
61 *Schutte & Koerting Co.

Thermo-Panel Coils.....Take the place of old-fashioned pipe coils. Assure increased capacity. Complete facts & prices of the latest models are available.
TL237 *Dean Products, Inc.

Vortex Tube.....is the answer to small scale refrigeration or cooling requirements. Bulletin K-8 contains information on Hilsch Vortex Tube for hot & cold running air.
T248 *Fisher Governor Company

Instruments & Control

Analyzer.....The Unitized gas analyzer is reduced to the essentials consistent with highly efficient O_2 measurement & control. Pertinent details in folder ND46-91 (5).
62 *Leeds Northrup

Chromatograph, Gas.....Instrument for monitoring multiple components in a complex process stream. Detailed instrument specifications in data file 2P-1-14.
57 *Beckman Instruments, Inc.

Computer.....Libratrol-500 is a complete digital process control computer packaged for on-line applications. Details include its application to process control systems.
47 *GPE Controls, Inc.

* From advertisement, this issue

NOW!

Distill up to 4000 pounds per hour for less than 1/10 cent per pound!

NEW CEC continuous production HIGH-VACUUM STILLS

- Lower operating cost than any other chemical process: .06 to .1 cent per pound.
- High throughput, continuous operation: 4 sizes, from 2 to 4000 pounds per hour.
- Safe! Low-speed rotor. No possibility of oxidation.
- Simplest operation. Low maintenance—runs virtually unattended.
- Highest yield—less product loss from decomposition or molecular rearrangement of heat-sensitive materials.

WRITE for specifications and application data, Bulletin 3-1 . . . and for information on test runs of your samples.

Now CEC stills give you the most economical and efficient way to separate organic and silicone compounds from 250 to 4000 molecular weight; for example:

Fatty acids
Polymerized acids
Esters
Plasticizers
Waxes
Vegetable oils
Pharmaceuticals
Epoxy resins
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Impregnating oils
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Silicones
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Product-rich residues

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Handles Severe Corrosives... "Round-the-Clock"

ECO MINILAB

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- 0 to 2 g.p.m.
- Hastelloy C and Teflon construction
- Self-Lubricated
- Non-contaminating
- Can be steam or chemically sterilized

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ECO ENGINEERING COMPANY
12 New York Ave., Newark, N. J.

LITERATURE . . .

Computer.....Booklet outlines some of the major benefits and features of the new Univac computer. Advanced solid-state computer design and new data processing concept.
230A Remington Rand

Computers.....The LGP-30 provides fast, accurate answers in all types of statistical studies . . . analysis of variance, regression analysis, etc. Information & specifications.
38 *Royal McBee Corporation

Continuous Voltage Stabilizer..... This new unit accurately regulates the D-C reference voltage supply to measuring circuit. Full details available.
22-23 *Minneapolis-Honeywell

Control.....FultroMatic combines controller, positioner, valve . . . gives precise control of temperature or pressure. Complete specifications in Bulletin NC-755.
201 *Robertshaw-Fulton Controls Co.

Control.....Handbook, "Modern ph and Chlorine Control" is available. It gives complete theory and describes the complete line of controls.
R233a *W. A. Taylor & Co.

Control, Liquid Level.....is available for controlling level changes from ⅛" to 150 ft. Multi-stage switching when desired. More details on request.
B246 *Magnetrol, Inc.

Control Panels.....Illustrated Bulletin 170 presents information on packaged automatic control panels for gas-engine-driven compressors. Three basic panels are described.
230B Clark Bros. Co.

Control Panels.....Bulletin describes various automatic control systems used throughout industry. Panels can be built to user specifications or designed for specific duty.
230C Control Panel Corp.

Controller.....The complete story on the Dynalog Electronic Controller with full-scale spans as narrow as 5 F. is contained in Bulletin 20-10. Send for your copy.
119 *The Foxboro Co.

Gas Meters.....New line of high-pressure rotary meters for 600 PSIG service available in 4 sizes, covering a range of from 84,000 to 1,600,000 scfh. Data Sheets.
43 *Roots-Connersville Blower

Gauge.....The USG A-line meets A.S.E. Grade A standards, including accuracy of 1%. Wide choice of options. Complete details in Catalog 306.
116b *United States Gauge

Gauges.....Catalog 1819 contains information on Supergauge, Mono-Unit design and Arc-Loc movement. Details on a comprehensive line of indicating dial gauges.
116a *United States Gauge

Instrument.....The completely electronic Pfaudlertron glass tester gives a fast, visual signal when testing for exposed metal. Facts in Bulletin No. 970.
30-31f *Pfaudler Permutit Inc.

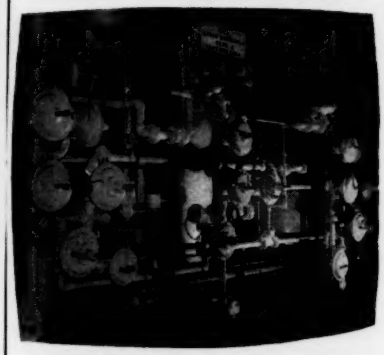
Instruments.....for temperature, pressure & humidity applications . . . in literally thousands of commercial & industrial projects . . . routine, special & classified. Catalogs.
238 *Weksler Instruments Corp.

* From advertisement, this issue

THESE NEW IDEAS HAVE COME FROM

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR **ionXchange**



Illinois Water Treatment Co. was incorporated over 20 years ago to use the newly-discovered resins in the development of ionXchangers.

1942 By this time, IWT had already built more than 50 successful multi-bed ionXchangers (some of which are still in use today).

1943 IWT brought "automation" to ionXchange with the introduction of automatic ionXchangers, some of which were very large. (Some of *these* are still operating today, also.)

1947 This was the year when IWT brought out the first large (400 gpm) ionXchanger for silica removal.

1949 IWT built the first commercial *Mixed Bed* ionXchanger.
(U.S. Patents 2605084 2771424)

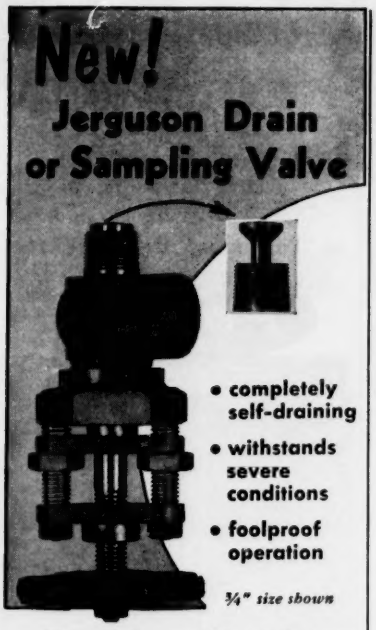
1954 A huge 5,000 gpm fully-automatic mixed-bed ionXchanger was designed and built by IWT to remove silica from make-up water for high-pressure boilers. This plant has now de-ionized over SIXTY BILLION pounds of water.

1957 IWT introduced "Counterflow," the first really new idea in multi-bed ionXchangers since the introduction of silica-removal techniques. (Patent pending.)

THIS EXPERIENCE CAN MEAN A LOT TO YOU

These ideas, and other IWT developments, can mean reduced costs, improved operations, and greater efficiency in your plant. *Check with your IWT representative.*

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.



The new Jerguson No. 23 Drain or Sampling Valve is completely self draining, for the valve stem seats on the outside of the valve body. It is ideal for installations where it is desirable to have the valve seat inside the wall of a vessel in order to prevent the typical condition of liquid remaining in the nipple and valve inlet.

This rugged, new Jerguson Valve has outside screw and yoke construction to meet high temperature or corrosive conditions where inside threads cannot be tolerated. The efficient outside thread design eliminates possible freezing and allows the valve stem to work freely at all times. The No. 23 Valve provides foolproof operation because the stem is constructed with a left-hand thread, thus allowing the valve handle to operate in the normal direction of standard valves.

Available in sizes from ¾" to 2" N.P.T. ¾" and 1" sizes are recommended for pressures of 4000 lbs. @ 100° F. and 1000 lbs. @ 750° F.; 1¼, 1½ and 2" sizes are recommended for 600 lbs. @ 100° F. and 250 lbs. @ 750° F. Optional features include construction with additional outlet for such uses as a steaming out connection and with a reamer on the end of the stem to break away encrusted matter which may have collected on the inside vessel wall.

Write for data unit and complete details.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

LITERATURE . . .

Liquid Level Gages.....Detailed information on the construction, design features and specifications of a nonfrosting liquid level gage line is topic of new literature.
231A Jerguson Gage & Valve

Measurement & Control.....Gagetron provides permanent, efficient control & measurement under severe operating conditions in process vessels or piping.
202 *Instruments, Inc.

Meters.....Inline electronic turbine type meters offer capacities from 0.1 GPM to 40,000 GPM. Information on this type plus Xacto Meters & Proportioneers in Catalog.
85 *Bowser, Inc.

Meters.....for hot or cold liquid measurement. Meters measure volumetrically . . . each mutating cycle of the piston displaces a fixed volume. Literature.
190 *Buffalo Meter Co.

Precision Instrument Components..... Catalog 20 lists over 10,000 items, including gears, shafts, collars, couplings, speed reducers and other precision items.
231B PIC Design Corp.

Readout Lamps.....Pamphlet discusses the phenomenon of electroluminescence and its application in lamps for display of numerical or alphabetical information.
231C Westinghouse

Ring Balance Meter.....Bulletin MSP-160 describes the many applications for Hagan Ring Balance meters. Publication highlights all outstanding features.
231D Hagan Chemicals & Controls

Rotameter.....Series 1112 Full-View Rotameters feature dowel-pin, side-plate case construction. Design Specification Sheet SS-111-2 for information.
R234 *Brooks Rotameter Co.

Sight Flow Indicators.....Catalog provides information on sizes, materials, pressure-temperature ratings and dimensional specifications on line of indicators.
231E Jerguson Gage & Valve

Thermocouple Wire.....Catalog describes new line of thermocouple wire. Presents in tabular form, an all new line of wires with respect to gage and insulation.
231F Harco Laboratories

Pipe, Fittings, Valves

Expansion Joints.....Self equalizing expansion joints absorb movement in any direction, axially, laterally, angularly, or any combination of these. Catalog 56.
63 *Zallea Brothers

Fittings.....Glassed-ductile iron fittings have high thermal shock and corrosion resistance. Complete information contained in Bulletin No. 977.
30-31b *Pfaudler Permutit Inc.

Fittings.....Forged steel fittings give you the added resistance to pressure, heat, corrosion, shock & vibration needed. Specifications on request.
215 *H. K. Porter Co., Inc.

* From advertisement, this issue

NEW! ERIEZ
HI-VI VIBRATORY FEEDERS & BIN VIBRATORS

specially constructed for
HAZARDOUS, DUSTY LOCATIONS

First Mill Mutual Acceptable electro-permanent magnetic vibratory equipment at economical prices!

Vibratory Feeders – accurately feed and control bulk materials, from ounces to tons. Completely enclosed drive element, built-in glass fiber springs, impotted epoxy sealed electrical coil. Needs no rectifier.

Unit (Bin) Vibrators – keep hard-to-move materials flowing through bins, chutes, etc. Exclusive pinpointed vibration impact. Completely enclosed and sealed. No sliding or rotating parts to wear. No rectifier needed.

WRITE FOR BIG VIBRATORY FACT FILE
Eriez Mfg. Co., 74-U Magnet Dr., Erie, Pa.

ERIEZ

PUMPING MOLTEN CHEMICALS?

write TABER

Whatever your pumping needs.. why not put it up to Taber.. long experienced pump specialists. Vertical pump illustrated, 19,478, for pumping molten chemicals. Horizontal pump, 6043, handles black liquor, caustic, etc., in evaporator service; or transfers fluids under vacuum.

WRITE, ON BUSINESS STATIONERY FOR BULLETIN V-837

TABER PUMP CO.

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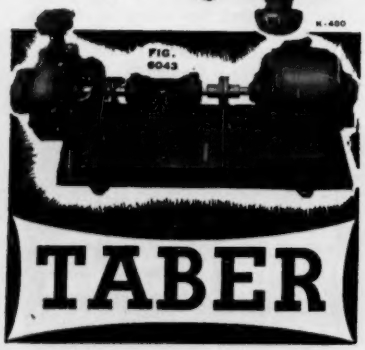
291 ELM ST.
BUFFALO 3, N. Y.



TABER

LITERATURE . . .

Flexible Connectors.....Engineering services for design & development of connectors to meet special applications. Bul. TC-101 "Anaconda Flexible Connectors of Teflon."
11 *American Brass Company

Hose.....Teflon hose that really flexes, even in uarge diameters. Available in lengths to 25 feet & diameters of ¾", 1", 1¼", 1½" & 2". Data Sheets.
121 *Titeflex Inc.

Pipe & Fittings.....New PVC rigid plastic pipe & fittings technical brochure is available. Covers specifications and other details of interest.
212 *Mueller Brass Co.

Pipe, Plastic.....Uscolite type pipe is non-contaminating, odorless, imparts no taste or discoloration. Details on these types & also Usco-Flow HT type.
183 *United States Rubber

Pipe, Plastic.....PVC pipe is available in all sizes from ¼" to 12" with plastic valves & fittings. Complete information & technical data found in brochure.
1 *Kraloy Plastic Pipe Co., Inc.

Pipe, PVC.....performance data is available on corrosion resistance, allowable stress, temp., pressure, impact, vibration, etc. New 32-page illustrated catalog offered.
93 *A. M. Byers Co.

Swivel Joints.....DS series swivel joints are recommended for chemical services ranging from −40° to +400° F & 300 psi. Bulletin 1258 for complete details.
30-31a *Chiksan Co.

Tubing.....Lectrosonic designed to meet need of petrochemical industry for electric resistance welded carbon steel that is easily workable, strong, etc. Bul. TB-431.
126 *Babcock & Wilcox Co.

Tubing Stainless Steel.....Annealing is one important step to assure you ductility & maximum resistance to corrosive agents. Complete details on selection of materials.
R236 *The Standard Tube Co.

Tubing, Stainless Steel.....All welded stainless steel tubing is cold drawn & inspected by Magne Gauge. The new Tubing Brochure is available on request.
191 *Wallingford Steel Co.

Valve.....The new drain or sampling valve is completely self-draining & withstands severe conditions. Data unit and complete details available on request.
L231 *Jerguson Gage & Valve Co.

Valve.....Data Sheet No. 42 covers the glassed flush valve. This valve is available in sizes from 1½x1 to 8x6 in six different models. Send for your copy.
30-31b *Pfaudler Permutit Inc.

Valve.....Brochure on the "O-Seal" is offered. Recommended for all general services—air, gas, water, steam, propane, hydrocarbons, etc. as well as for hard-to-hold services.
95 *Wedgeplug Valve Co.

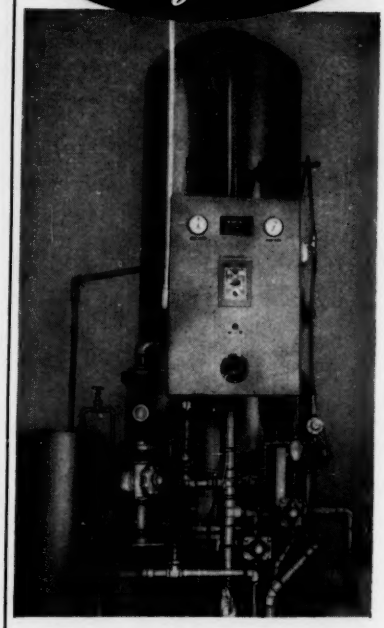
Valve, Ball.....The Econ-O-Miser is available in many combinations of seats, O-Rings & body materials. Complete technical information in "Comparison" bulletin EB 101.
14-15 *Worcester Valve Co., Inc.

* From advertisement, this issue

Need Ultra-Pure Process, Make-Up or Rinse Water?

Check the pioneer maker* of "Packaged" Demineralizers

Penfield



- **Purity in excess of 15-meg ohms** — where you need it, in the quantities you need.
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- **Shipped Completely "Packaged"** — each unit is ready to operate when you receive it.

Penfield Demineralizers are available in mono-column, dual-column and multi-column types — in flow rates from 10 to 10,000 G.P.H. Fifty standard models to choose from. If complete system engineering is needed, that's a Penfield specialty too.

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MANUFACTURING CO., INC.
19 High School Ave., Meriden, Conn.

**Penfield pioneered "packaged" demineralizers for American industry — and remains today the only manufacturer exclusively making demineralizing equipment.*

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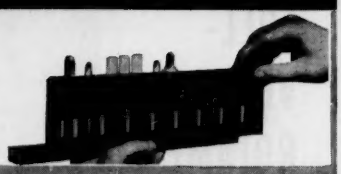


TAYLOR COMPARATORS

Make pH, Chlorine, Phosphate Tests in Minutes

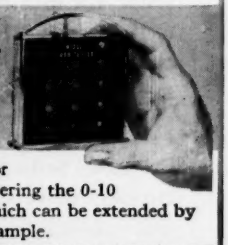
Here's a really fast way to get data for trouble-free chemical processing, water purification, and waste treatment operations. Taylor Comparators give you quick, accurate pH, chlorine or phosphate determinations that help you control many chemical processes. To test, just fill the middle test tube with treated sample and move color standard slide across until colors match. You then read values direct from the slide. The entire operation takes only minutes.

For Complete Water Analysis

TAYLOR WATER ANALYZER

Make fast, accurate tests for color, ammonia, nitrite, nitrate, chlorine, total iron, manganese, silica, copper, fluoride, bromine, aluminum, nickel and low chromate simply by using separate color standard slides with basic set.

New MIDGET IRON TESTER



Contains color standards covering the 0-10 ppm range which can be extended by diluting the sample.

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All Taylor liquid color standards carry an unlimited guarantee against fading. Use only Taylor reagents and accessories with Taylor Comparators to assure accurate results.

SEE YOUR DEALER for Taylor sets or immediate replacement of supplies. Write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full line.

W. A. TAYLOR AND CO.
414 STEVENSON LANE • BALTIMORE 4, MD

LITERATURE . . .

Valve, Plug.....New 1000-lb round opening valves available in 2"x2½" size with API line pipe thread for production, pipe-line, refinery, etc. services. Bul. V-611.
65 *Rockwell Mfg. Co.

Valves.....Type F valves are available from ¼" thru 4" in nine standard corrosion resisting alloys. Complete details contained in Bulletin V/4b. Send for your copy.
181 *The Duriron Co., Inc.

Valves.....Information pertaining to working pressures, specifications, construction features and applications for small valves for general use is topic of catalog.
233A Kerotest Mfg. Co.

Valves, Chlorine.....now in sizes up to 6". For all water-free chlorine gas or liquid services up to 300 F. Ideal for chlorinating lines in chem. processing, etc. Specifications.
105 *Crane Co.

Valves, Diaphragm.....Straightway provide streamlined flow, positive closure, complete isolation of operating mechanism, minimum maintenance, etc. Information.
60 *Grinnell Company, Inc.

Valves, Fittings, Flanges & Unions..... Catalog F-10 contains the complete line available to industry. Its 432 thumb indexed pages feature new types & trims for all conditions.
130 *Henry Vogt Machine Co.

Valves, Full Flow.....Bulletin 500-1 contains eight pages of diagrams and detailed descriptions of the different models of Sentry valves that are available.
233B *Coppus Engineering Corp.

Valves Safety Relief.....Catalog 88 gives detailed information on a full line of safety relief valves for a wide range of industrial services. Sizes to 6 in. Many materials.
233C Marine & Industrial Products

Weld Clamp.....stops pin hole leaks or splits in welds on welded steel pipe lines. Each clamp is tested to 800 pounds line pressure. Details in catalog.
175 *M. B. Skinner Co

Process Equipment

Airlock Feeders.....Bulletin P58 "How to Select a Rotary Airlock Feeder" is now available on request. Airlocks solve many processing problems.
B249 *Prater Pulverizer Co.

Ball Mills.....are noted for high tonnage & low cost processing of phosphate rock & other agricultural chemicals. High capacity & product fineness. Details.
40a *Kennedy Van Saun Mfg.

Blender, Ribbon.....is designed to give top mixing efficiency & meet sanitary codes. Nine different size units ranging from 16 to 300 cu. ft. working capacity.
101 *The Strong Scott Mfg. Co.

Blenders.....Liquid-Solids units blend up to 40% liquids by weight. Blending requires minutes, not hours. All surfaces of the blender are freely accessible. Information.
70-71 *Patterson-Kelley

* From advertisement, this issue

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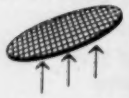
a filter man's thinking

"Expediency: when time is more precious than gold (or platinum)"

BY JULES P. KOVACS, V. P., PUROLATOR PRODUCTS, INC.

There's more than one way to skin a cat . . . or filter a chemical that fights any attempt to tame it.

As an example, here's a problem we recently licked in developing a diffusion plate bed support for a highly corrosive gaseous fluidized bed reactor, operating at very high temperatures. Pore size had to be 25 microns, able to support 20 psi. And it was needed in *a hurry*.



Now, anyone who knows filters could pick metals for such a job. The obviously ideal medium would be inconel. Trouble was, it was impossible to obtain a fine enough inconel screen. Of the only other metals that could withstand the corrosive action, gold lacked high temperature strength; platinum was too weak without support and too costly, though it did offer the high temperature strength and corrosion resistance needed. And that's where Purolator's special capabilities came into play.

Our engineers solved it by combining the finest mesh size of platinum available–150–with a fused facing of porous gold powder to reduce pore size to the specified 25 microns — and supported by inconel grids. Problem solved. Customer deadline met.

Au. Pt.

But the story doesn't end there. Purolator engineers immediately set about to find a way to take advantage of standard inconel mesh economy for similar applications. This is how we do it: inconel metallic edge type units are sliced in two, and two of equal thickness are punched out. One is rotated 90° from the other and fused by Purolator's exclusive process. By carefully controlling the amount of fusion material, we produce the exact pore size required. Simple?

It's *not* simple, of course. But it's typical of Purolator's complete service for special jobs. We live with challenges all the time. Want to read about some? Our brochure called "New Roles for Filtration" is just off the press and it will be interesting reading. Send for your copy.

Filtration For Every Known Fluid

PUROLATOR PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

LITERATURE . . .

Centrifugal.....The Batch-O-Matic speeds processing & assures product uniformity. Features a low, compact design. Illustrated details are available.
R211 *American Machine & Metals, Inc.

Centrifugal.....The Continuous Solid Bowl Centrifugal comes in 7 sizes, each subject to 25 variations of design. Capacity from 200 to 120,000 lbs. per hour.
2 *Bird Machine Co.

Centrifugal Pumps & Valves.....This equipment is designed in titanium specifically for the highly corrosive environments found in chemical plants.
33-34d *U. S. Industrial Chemical Co.

Centrifuge.....A packaged centrifuge for in-plant production line testing. It has 6000 gal/hr capacity & is complete with required pumps, valves, controls, etc. Bul. 946.
30-31g *Pfaudler Permutit Inc.

Classifier.....The "Overdrain" Classifier is a completely new device in the field of mechanical wet classifiers. Acid-proof construction available. Catalog 39-C-11.
213 *Hardinge Co.

Deaerators.....Type A handles up to 3,000,000 lbs/hr. Type B processes 150,000 lbs/hr. Both are available in either horizontal or vertical designs. Bul. No. 2357.
30-31c *Pfaudler Permutit Inc.

Demineralizers.....are available in mono-column, dual-column & multi-column types . . . in flow rates from 10 to 10,000 GPH. Fifty standard models. Catalog.
R232 *Penfield Mfg. Co., Inc.

Dryers, Spray.....A new full-color bulletin SW 401 "Swenson Parallel Flow Spray Dryers" gives information on evaporators, pulp washers & crystallizers.
83 *Swenson Evaporator Co.

Dynamic Washers.....The UW-4 washers are ideal for high loading conditions where maximum efficiency is desired. Self-cleaning & fire & explosion proof. Bul. W-7456.
44 *The Ducon Co., Inc.

Ejectors, Steam Jet.....A wide range of single-stage & multistage types for maintaining low absolute pressures in refineries, chemical plants, etc.
R207 *Elliott Company

Filter Papers.....are used in plate & frame presses, horizontal plate, sheet & pad, ceramic gravity, etc. Samples of filter papers are now available.
BL237 *The Eaton-Dikeman Co.

Filter Press.....can handle most filterable mixtures & most filter media. Catalog includes details of Sperry's Plate-Shifters, Closing Devices & other accessories.
209 *D. R. Sperry & Co.

Filters.....Positive self-cleaning edge-type, automatic self-cleaning wire wound type, disposable depth cartridge type, porous metal type, & screen mesh type.
55 *The Cuno Engineering Corp.

Filters.....The new brochure called "New Roles for Filtration" contains complete information about filtration for every known fluid. Available on request.
L234 *Purolator Products, Inc.

* From advertisement, this issue

NEW FULL-VIEW® ROTAMETER

Interchangeable metering tubes snap in and out . . . in seconds! It's that easy to change range or to service the new Brooks Series 1112 Full-View Rotameters.

A stainless steel leaf spring (entirely isolated from the process fluid) holds the tube perfectly in position, yet allows removal with just a simple up-and-out movement. No tools necessary.

Special O-ring construction and tube adapter assemblies make this time-saving convenience possible. Up to four different size metering tubes may be interchanged in a single case by merely changing adapters.

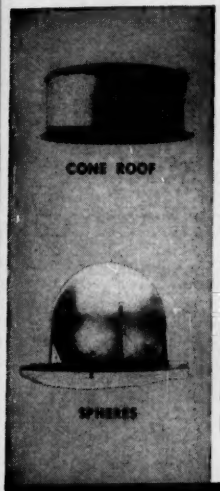
Like all Full-View Rotameters, the new Series 1112 features Brooks' dowel-pin, side-plate case construction. Thoroughly proven in service, this practical construction gives the meter case rigid strength, protects the glass metering tube from all line strain.

For More Information, Request Design Specification Sheet SS-111-2

BROOKS ROTAMETER COMPANY

857 A STREET, LANSDALE, PA.

B.A. 1937



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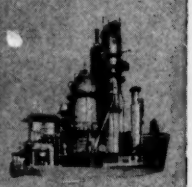

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Sales offices throughout the U.S.A.

LITERATURE . . .

Filters, Dust.....The Dynaclone operates continuously, 24 hours a day. Has new "Resist-O-Wear" filter bags. A 36-page catalog is offered. No. 104.
192 *The W. W. Sly Mfg. Co.

Filters, Pressure Leaf.....Bulletin No. 146 outlines the horizontal tank, vertical leaf filters and the vertical tank, vertical leaf filters. Send for your copy.
198 *T. Shriver & Company, Inc.

Gas Scrubbers.....design allows for use of materials resistant to corrosion, abrasion or high temp. Data on Chemico verturi scrubbers contained in a new brochure.
39 *Chemical Construction Corp.

Homogenizers.....Illustrated bulletin covers the construction and operation of the Gaulin Industrial Homogenizer. Also covers the theory of homogenization.
235A Manton-Gaulin Mfg. Co., Inc.

Hydrator.....Bul. 1286 outlines the C-41 Super-D-Hydrator. Capacity on typical polyolefin dehydrations generally ranges from 2000 lbs/hr. to around 6000 lbs/hr.
110 *The Sharples Corp

Impact Mill.....for closely controlled particle size reduction with no grinding tolerances to maintain. Complete literature on all equipment available.
BL227 *Entoleter Div., Safety Industries

Laboratory Vacu-Film Processor..... Areas of application, from isolation of essences & removal of odors & color bodies to purification of pharmaceuticals, etc. Bulletins.
66c *Rodney Hunt Machine Co.

Micronizers.....grind & classify in one operation in a single chamber. Classifying is simultaneous & eight models are available. Full description in Bul. No. 091.
L207 *Sturtevant Mill Co.

Mills.....The Pebble & Ball Mills are available in a complete range of sizes from 40 to 13,000 lb. capacities, for dry or wet grinding, mixing or blending. Cat. 77.
R225 *Abbe Engineering Co.

Mills, Impact.....available in sizes to meet any requirement. The most efficient method of achieving particle size reduction by centrifugal force is covered in a bulletin.
235B Safety Industries, Entoleter Div.

Mixer.....New Model RL Hi-Shear offers finer, faster blending, dispersing & homogenizing. Features controllable flow pattern. All parts stainless steel. Information.
197 *Gabb Special Products, Inc.

Mixer.....The "5" size Lightnin Mixer is available with ratings from 40 hp to 150 hp with double-reduction gearing, & from 10 to 50 hp with triple reduction. Details.
252 *Mixing Equipment Co.

Mixers.....Readco lab & pilot type 316 handles even heavy viscous material. Available from stock in 1, 3, 6, 20 & 40 qt. working capacities. With fixed or variable speed drives.
41 *Read Standard

Mixers, Centrifugal.....A compact unit adaptable to continuous or batch system. The new principle of high speed mixing producing intimate dispersion listed in bulletin.
235C Safety Industries, Entoleter Div.

* From advertisement, this issue

Helpful Books for Chemical Engineers

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Just Published — Fully covers the basic theory, design methods, equipment, production techniques, and testing of adhesive bonded structures and products. Shows the most effective ways to join reinforced plastic parts with each other and with parts made of metals and other isotropic materials. Covers resin mixing, surface preparation, spraying, assembly, heat curing, etc. By **H. A. Perry**, Naval Ordnance Lab., White Oak, Md.; Technical Coordinator, **R. H. Wagner**, Owens-Corning Fiberglas Corp. **288 pp., 176 illus., $8.75.**

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Mass and Energy Balances

Just Published — Gives a comprehensive coverage of "first law" thermodynamics and phase diagrams, along with a useful explanation of material-balance calculations. Methods of computation and process analysis are stressed in this engineering treatment. Develops thermodynamics and principles of equilibrium as applied to distillation, absorption, extraction, etc. By **E. J. Henley**, Stevens Inst. of Tech.; and **H. Bieber**, Esso Research and Engineering Co. **441 pp., 139 figures and tables, $9.00.**

HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE

Just Published — A broad treatment of theoretical principles and experimental techniques of high resolution nuclear magnetic resonance. Describes applications in molecular structure determinations, isomerism, conformational analysis, tautomerism, hydrogen bonding and other intermolecular effects, chemical equilibria, reaction rates, and chemical analysis. By **J. A. Pople, Cambridge Univ.**; and **W. G. Schneider** and **H. J. Bernstein**, both of National Research Council of Canada. **512 pp., 199 illus., $13.50.**

HANDBOOK OF MATHEMATICAL TABLES AND FORMULAS

Presents the most important formulas and theorems of algebra, trigonometry, calculus, and vector analysis. Includes logarithmic and trignomeric tables; tables of natural logarithms, exponential and hyperbolic functions, probability functions, squares, cubes, square roots, cube roots, reciprocals, and other numerical quantities. By **R. S. Burington**, Bureau of Ordnance, Navy Dept. **3rd Edition, 296 pp., $3.00.**

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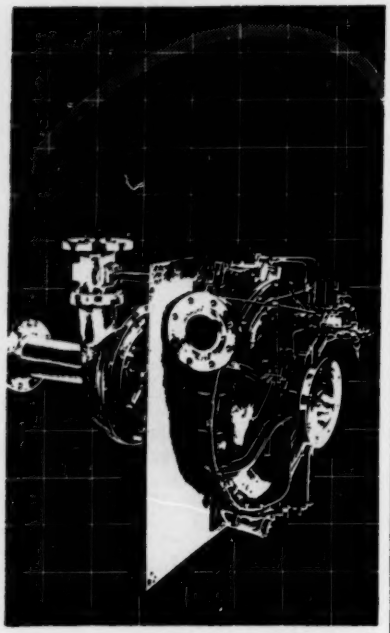


A new family of turbines, with guaranteed efficiencies of from 75% to well over 80%, reduced installation requirements and long and trouble-free service, is now being produced by Stratos. Earning an excellent reputation in the chemical and petrochemical industries, these turbines are available in flow ranges from as low as 20 scfm to over 1500 scfm.

They include turbines for low-temperature applications (down to −400°F) and for high temperature uses (up to 1200°F). Designed to operate at pressures up to 3000 psi, these turbines owe their high efficiency to their aerodynamic cleanliness, low wetted areas—and to the attention paid to detail in aerodynamic, thermodynamic and mechanical aspects of each design.

Reliability and safety are designed into each Stratos unit. Warranted long life precludes frequent downtime for maintenance. Special features, such as fluid sealing and overspeed protection, are incorporated when required.

For further information on Stratos turbo-expanders – and industrial compressors—write to:

STRATOS

INDUSTRIAL PRODUCTS BRANCH

Bay Shore, L. I., New York

A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION

LITERATURE . . .

Mixing.....Mix-Muller offers 3-way kneading, smearing, spatulate action. "Handbook on Mulling" as well as a list of Mix-Muller users are available.
118 *National Engineering Co.

Process Equipment.....Catalog 356-R on Buflovak's Processing Kettles and Catalog 381 on the Buflovak Laboratory are now available on request.
53 *Blaw-Knox Company

Rotating Vacuum Dryers.....available in six standard sizes with a working capacity ranging from 3 to 150 cubic feet. Details of dryer sent on request.
115 *F. J. Stokes Corp.

Screens, Vibrating.....available in different sizes. Bulletin outlines the important new design & capacities for long life under rugged conditions.
236A Safety Industries, Entoleter Div.

Space Filter.....Performance, construction and installation details of the new Dustfoe space filter are described in Brochure 1505-6. For industrial applications.
236B Mine Safety Appliances

Spray Nozzles.....Line of spray nozzles that produce coarse, uniformly distributed, hollow-cone sprays of liquid in medium to large quantities is the topic of new bulletin.
236C Schutte & Koerting

Spray Nozzles.....Complete choice of design types, thousands of capacities to choose from, & choice of materials for chemical compatibility. Catalog 24.
T247 *Spraying Systems Co.

Strainers.....Automatic, self-cleaning strainers for efficient removal & disposal of suspended particles from raw or process water & other liquids. Bul. 500.1C.
TR237 *S. P. Kinney Engineers, Inc.

Stills, High Vacuum.....available in 4 sizes from 2 to 4000 pounds per hour. Specifications & application data contained in Bulletin 3-1. Send for your copy.
R229 *Consolidated Electrodynamics

Testing Sieves.....Feature exact openings, no crevices, strong durable cloth, & cloth is renewable. Sieves available in a complete range of sizes.
210 *Newark Wire Cloth Co.

Turba-Film Processor.....consists of a series of rotor blades operating within a thermal section & a separating section . . . all fabricated of alloy steel. Bul.
66a *Rodney Hunt Machine Co.

Turbo-Mixer.....Detailed information & useful design data contained in the Turbo-Mixer Bulletin. Processing of a wide variety of metals & ores.
81 *General Amer. Trans. Corp.

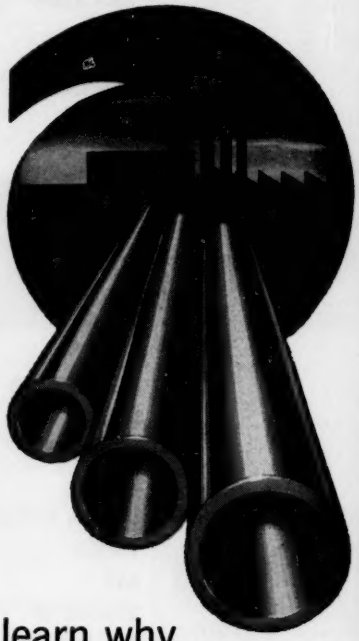
Vacu-Film Processor.....Designed & calculated to meet specific processing requirements as determined by nature of process & physical & thermal characteristics of product.
66b *Rodney Hunt Machine Co.

Vibrating Screens.....New 48-page book presents information on the versatility of the largest selection of vibrating screens in the world. Selection data and illustrations.
236D Link-Belt Co.

* From advertisement, this issue

know the facts about annealing

before you specify stainless steel tubing for chemical applications!



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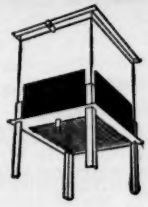

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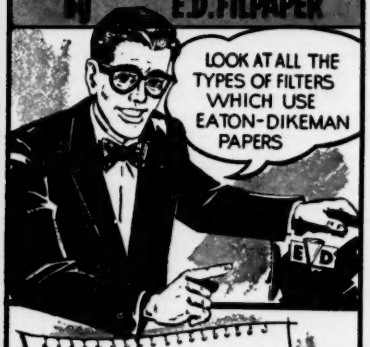

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LITERATURE . . .

Pumps, Blowers, Compressors

Air Conditioning System.....Rotaspray units operate at high air velocity (2600 fpm) & are available in four sizes 10,500 to 30,000 cfm. Complete information.
42 *Carrier Corporation

Air and Vacuum Pumps.....Catalog 359 describes rotary positive air and vacuum pumps, gas boosters and air motors. Gives details on construction and capacities.
237A Leiman Bros.

Blowers.....operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 11 production models range from 50 to 4000 CFM. Information.
224 *M-D Blowers, Inc.

Compressors.....for every processing requirement. Pressures to 15,000 PSIG, sizes to 5000 HP. Available in belt, motor or steam drive, lubricated or non-lubricated.
24-25 *Chicago Pneumatic

Duct Fans.....New line of belt-drive duct fans, in sizes from 12 to 60 in., is described in Bul. A-114A. Fans have adjustable sheaves that permit quick adjustment.
237B Hartzell

Motorpumps.....offer easy installation, a wide range of sizes & types, mounting versatility, low operating cost, & rugged durability. Specifications & performance data.
226 *Ingersoll-Rand

Pump.....Literature on the Lab and Pilot Plant pump is available. Hastelloy C and Teflon constructed. Self-lubricated and noncontaminating.
L230 *Eco Engineering Co.

Pump Non-Clog.....Bulletin describes the varied applications of the non-clog Torque-Flow pump. Highly resistant to abrasion, pump handles delicate materials without damage.
237C Western Machinery Co.

Pumps, Acid.....are available with pumping parts of machineable alloys as well as plastic to meet every need in handling of corrosives, hot liquids & other solutions.
251 *A. R. Wilfley & Sons, Inc.

Pumps.....to handle liquid oxygen & other liquefied gases, which can be liquefied only at very low temperatures. Special features are outlined in Bul. 203-7.
222 *Lawrence Pumps Inc.

Pumps.....Centrifugal and rotary pumps for a wide range of industrial uses are described and illustrated in catalog. Ratings from 1/20 to 5 hp. Capacities to 148 gpm.
237D Pioneer Pumps

Pumps.....Moyno pumps are available in nine sizes with capacities ranging from minimum metering flow to 500 gpm and pressures from zero to 1000 psi. Bul. 30 CE.
179 *Robbins & Myers, Inc.

Pumps.....Bulletin V-837 covers vertical pumps for pumping molten chemicals and horizontal pumps for handling black liquor, caustic, etc., in evaporator service.
L232 *Taber Pump Co

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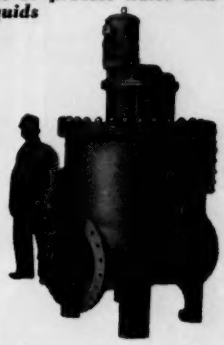

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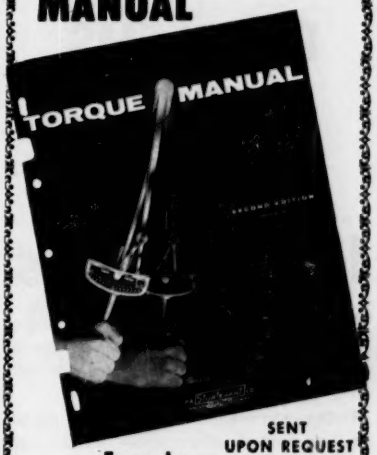

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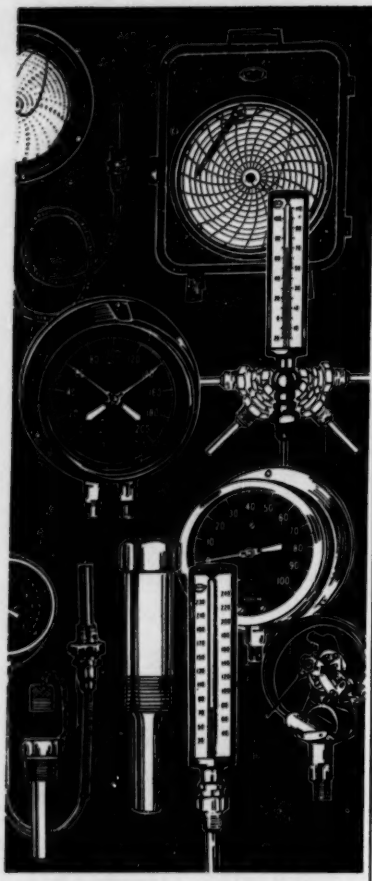

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LITERATURE . . .

Pumps.....Single-stage, end suction pumps are available in capacities from 10 to 200 gpm. Feature vibration free shaft. Descriptive Bulletin No. 500 is offered.
214 *The Weiman Pump Mfg. Co.

Pumps, Fire.....available for high pressure sprinkler systems, or foam smothering systems in every kind of commercial or industrial installation. Bul. B-1500.
51 *Food Machinery & Chem. Corp.

Pumps, Liquor.....Bulletin 245 covers types L, LS and A for pumping erosive and corrosive liquids, hot or cold. Contains illustrations and a chart of approximate dimensions.
238A Warren Pump Co., Inc.

Services, Processes, Misc.

Ammonia Plants.....4 p. booklet titled "Ammonia" provides process information a flow sheet and photographs of Girdler-built ammonia plants.
238B Girdler Construction Div.

Devices & Equipment.....Bulletin 4300 presents a brief general description of the several types of SR-4 devices & their varied applications. Nineteen illustrated pages.
238C Baldwin-Lima-Hamilton Corp.

Electroplating.....20 p. booklet tells where & how to use rhodium electroplate. Amounts to a technical exposition of rhodium's unique metallurgical properties.
238D Sel-Rex Corp.

Filter Fabrics.....A handy book of information about filter fabrics is now available on request. It offers help in the selection of filter fabrics.
4 *Wellington Sears Co.

Filter Paper....."Netone" offers high tensile strength & high burst factor. Also abrasion, crease and chemical resistance. Free samples are available for testing.
220 *National Filter Media Corp.

Instruments, Laboratory.....16 p. Bulletin 1831 covers principles of chromatography, applications, natural gasoline analysis, accessories and description of instruments.
238E Consolidated Electrodynamics

Printed Weight Records.....The new Printweigh "400" provides complete printed weight records automatically. Full details contained in Bulletin 1157.
204 *Toledo Scale Corp.

Sodium Wire Extrusion System.....A new system has been developed for extruding metallic sodium in wire form. Described completely in a technical data sheet available.
33-34b *U.S. Industrial Chemicals Co.

Tile Tanks.....Steel-reinforced concrete tanks faced on both sides with vitrified tile laid with corrosion-resistant mortar provide attractive appearance, corrosion service.
238F Stebbins Engineering

Torque Wrench.....Manual contains formulas, application & engineering data. Also Screw Torque data, adapter problems and general principles.
BR237 *P. A. Sturtevant Co.

* From advertisement, this issue

author

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tar'i-an-ism (ô-thôr'i-târ'i-ăn
au·thor'i·ta'tive (ô-thŏr'i-tā'ti
from, authority; entitled to ob
thoritative teachings. 2. Ha
peremptory. — au·thor'i·ta·tiv
au·thor'i·ty (ô-thŏr'i-ti), n., p
auctoritas.] 1. Legal or rigi
son,
particular field; as, the Fort
hand; —
to, in support of opinic
mony; witness. b A prec
A book or its author. d Just
influence of
like. — Syn.
thŏr-i-zā'shŭn.
au'thor-ize (ô'thĕr-īz), v. t.
commission; as, authc
act.
sanction; as, customs
und for. — au'th
a'thor-ized (ô'thĕr-īzd), adj.
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1—1500 gal. Pfaudler, glass lined, jktd. agtd. Reactor.
1—500 gal. Walters, 304 S.S. jktd. agtd. Reactor.
1—550 sq. ft. Buflovak, monel, single effect Evaporator.
1—250 sq. ft. Buflovak, 304 S.S. forced circulation Evaporator.
1—3500 gal. 304 S.S. jktd. agtd. Tank, 9' x 7'.
1—7500 gal. 316 S.S. Vert. Storage Tank, 7' x 25' 50 PSI.
1—20,000 gal. 374 S.S. Vert. Storage Tank 12' x 23'.
1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
1—3000 gal. Aluminum Vert. Tank, 6' x 18'.
1—4000 gal. Haveg Vert. Tank, 8' x 12 .
1—12,000 gal. horiz. steel Pressure Tank, 7'6" x 36', 200 PSI.
8—Stainless Heat Exchangers; 1220, 942, 786, 536, 396, 315, 250, 157 sq. ft.

CENTRIFUGALS

1—Bird 18"' x 28", 316 S.S. Solid Bowl, Continuous.
1—Bird 18" x 28", steel, Solid Bowl, NEW, Continuous.
1—Bird 36" x 50", 347 S.S. Solid Bowl Continuous Centrifuge.
2—Sharples PY14, PN14, Super-S-Canters, 316 S.S.
1—Sharples H2 Nozzlejector, 15 HP, 304 S.S.
1—Bird 40" suspended, 347 S.S. perforated basket.
2—Sharples #16, 304 S.S., 3 HP motor.

FILTERS

1—Oliver 5'3" x 8' Steel Rotary Vacuum, vaporite housing.
1—Sparkler 33S28 Filter, 150 sq. ft. 304 S.S.
1—Niagara 36H110 horizontal Filter, 110 sq. ft., 304 S.S.
1—Sparkler 33-S-17 Steel Filter, 92 sq. ft.
1—#12 Sweetland Filter, 48 leaves, 3" centers, 640 sq. ft.
2—#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

DRYERS

1—Devine Vacuum Shelf with 19—59" x 78" shelves.
1—Devine Vacuum Shelf with 10—40" x 43" shelves.
2—Overton 42" x 120" Atmospheric Double Drum.
2—Devine 5' x 12', 4' x 9', Atmospheric, Single Drum.
1—Baker Perkins 5'6" x 6' Rotary Vacuum Dryer.
1—Buflovak 3' x 20' Rotary Vacuum Dryer, 316 S.S. Unused.
2—Louisville Rotary Steam Tube, 6' x 25', 6' x 50'.
4—Rotary Dryers, 4' x 40', 6' x 50, 5'6" x 50', 5" x 30".
3—Louisville 8' x 50' Stainless Steel lined Rotary Dryers.
1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
2—Link Belt; 7'5" x 25" Monel 6'4" x 24' S.S. Louvre Dryers.

MIXERS

1—Baker Perkins #16TRM, 150 gal. jktd., Vac. 50 HP.
5—Baker Perkins #15 JIM2 100 gal. jktd., 20 HP.
5—Day "Cincinnatus"' double arm, 250 and 100 gal.
3—1500# Powder Mixers, 7½ HP XP motor.
21—Steel, jktd. Powder Mixers: 225 and 350 cu. ft.

MISCELLANEOUS

1—HPM 88 ton horizontal Steeping Press.
2—Kent, Ross, 6" x 14" Three Roll Mills.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
4—Rotex Sifters: 40" x 84", 60" x 84".
3—Robinson Gyratory Sifters, 30" x 104", Triple Deck.
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REACTORS

2 Stainless 1000 gal. Vert. Jktd. Vacuum Reactors, Pancake coils.
Pfaudler 300 gal. Series E. Glass Lined Reactors.
Pfaudler Glass Lined Reactors up to 1000 gal. capacity; some jktd.
Rotating Jacketed Aluminum Vacuum Fermenter: 3'x8'.
1500 gal. Steel Jacketed and Agitated Heavy Duty Pressure Vessel.
A. O. Smith Stainless Lined 11,000 gal. Pressure Tanks: 10'x18'7".
ASME Aluminum Reactor 5050 gal. Manhole Type: 8'x12'; dished heads.
Lancaster Stainless Lined Rotary Reactor, 50"x17'4"; 350 PSI.

DRYERS

Proctor & Schwartz Apron Dryers: 8' wide S.S. Apron, 5 Sections; 34½' overall.
Buflovak Double Drum Lab. Dryer with Stainless Rolls 6"x8" in vacuum.
Stokes Rotary Jktd. Dryers: 18"x8' and 34"x10' ASME Jktd.
Rotary Jacketed Steel Dryer, 18"x8'. Louisville Rotary Kiln, 41"x15'.
Louisville Stainless Steel Rotary Dryer: 30"x28' completely equipped.
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Stainless Lined Rotary Dryer: 50"x20' with Combustion Chamber.
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Buflovak Double Drum Dryer 40"x120" Carrier Silica-Gel Dehumidifier.
Ft. Wayne Sterilizer 61"x124" with agitator and 5 HP motor.
American Sterilizer 30"x48"x54". 2 Monel Lab. Sterilizers: 16"x24".

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Baker Perkins Heavy Duty Double Arm Mixers from Laboratory Size to 300 gal. jacketed, S.S. Vac. Mixers; 150 & 300 gal.
NEW Falcon Double Ribbon Blenders, in Stainless or Mild Steel.
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Blaw Knox Conical Blender; 300 cu. ft., 9'6" dia.
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Whitlock Stainless Steel 17" x 10'; 250 sq. ft.
Monel Vert. Condenser with 192 Monel 1" Tubes; 2' x 8' 350 sq. ft.
Stainless Steel Condenser 350 sq. ft. 26" x 112"; 4 Pass.
Floating Head Shell & Tube Heat Exchanger; 16' long; 190 (¾" Tubes).
Acme Stainless Condenser; 24" x 16'; 1000 sq. ft.

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Sparkler Filters in Models No. 14, 18 and 33 . . . some Stainless.
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1—48" A.T.&M. Susp., T304 SS perf.

6—40" A.T.&M. Susp., T304 SS Solid basket, 40 HP, 1952.

1—40" Bird, susp. steel, imperf.
1—36" Tolhurst, bronze center-slung.
2—30" A.T.&M. susp., T304 SS.
1—30" Fletcher, underdriven, T304 SS.
1—26" Fletcher, underdriven, T316 SS.
1—26" Tolhurst, susp., steel perf.
1—12" Fletcher, underdriven, T304 SS.

CENTRIFUGALS, CONTINUOUS

4—Sharples Super-D-Hydrators, C-20 C-27, T316 SS, monel.
2—Sharples PN-14 Super-D-Canters.
7—Sharples #16, T304 SS.
2—Sharples #18V, vapor-tite.
1—Bird 18" x 28" horiz., T304 SS.
3—Bird 24" x 24", slotted screen monel.
1—Bird 32" x 50" horiz., T316 SS.
2—DeLaval #BUH-3930, T304 SS.

ROTARY KILNS—DRYERS

1—7'6" x 42' Kiln, ½" shell. 10' comb. chamber, UNUSED.

1—11' x 155' Traylor, ⅞" shell Kiln.
1—9' x 100' Vulcan, ⅝" shell Kiln.
1—8' x 170' ¾" shell, 3-tire Kiln.
1—8' x 115' ⅝" shell, 2-tire Kiln.
1—8' x 50' Vulcan, ⅝" shell Kiln.
2—7'6" x 100' ½" shell Kilns.
2—6' x 60' ⅜" shell Kilns.
1—4' x 24', 2-tire Kiln.
4—Hardinge 8'8" x 70' Dbl. shell dryers, #XA-18, welded, ½" shell.
1—7'6" x 65' dryer, ½" welded shell.
1—Allis-Chalmers 7' x 50' dryer.
1—6' x 50' Louisville dryer.
6—Steel dryers: 5'6" x 50', 4'9" x 32', 4'6" x 40', 4'6" x 32', 4' x 30', 3' x 15'.
2—Stainless dryers: 4'6" x 12', 3' x 10'.

TANKS

1—8000 gal. T304 SS, vert.
12—4500 gal. nickel-clad, vert. 125#.
1—3000gal. alum., vert., open.
1—10,500 gal., T304 SS, horiz., UNUSED, dished heads.
2—5700 gal., T304 SS, horiz., UNUSED.
4—Vacuum tanks w/coils, T304 SS: 3700, 3000, 2350, 1750 gal.
1—3400 gal., T304 SS, horiz.
1—2000 gal., T316 SS, hopper.
8—1750 gal., T304 SS, hoppers.
1—1400 gal., T316 SS, ASME, 175#.

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1—356 sq. ft. Devine, Steel.
2—108 sq. ft. Anderson, T316 SS.
2— 80 sq. ft. Devine, UNUSED.
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1— 12 sq. ft. Stokes, Steel.

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Type 316 Stainless Steel Equipment

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STAINLESS STEEL COLUMNS

1—108" Dia. Vulcan scrubber, 10 trays on 12" centers, 252—bubble caps per tray.
1—96" dia. x 13' high scrubber, 10 stainless steel trays on 12" centers, 276—caps.
2—96" dia. x 35' high bubble cap columns, 30 trays, 12" spacing, 272—caps per tray.
2—60" dia. x 13' high, Vulcan scrubbers, ¼" shell, 10 trays, 100—caps per tray.
1—48" dia. columns, 25 trays, bubble caps, T304-BLC SS.
3—30" dia. packed columns, 25' high, T316 SS.
4—24" dia. bubble cap columns, 12 trays, T316 SS, 18" spacing.—Vacuum.
2—20" dia. stainless steel columns, 25' & 30' high.

COPPER COLUMNS

1—72" dia. Vulcan bubble cap copper column, 46'10" high, 40—trays.—Vacuum.
2—48" dia. bubble cap copper columns, 25 & 40 trays, 31' & 45' high.—Vacuum.
2—42" dia. Vulcan stills, 66" high. (Evaporator bodys).
1—24" dia. column, 25'8½" long, 20 trays, bubble caps.

FILTERS—CRYSTALLIZERS

2—Bird-Young 4' dia. x 3' face rotary Vacuum filters. T316 SS, 40 sq. ft.
3—Sharples C-20 Super-D-Hydrators T316 SS.
1—Alco 60 sq. ft. vertical pressure leaf filter, T316 SS.
3—18,000 gal. Aluminum Cone bottom tanks, 12' dia. x 31' O.A.H.
4—1200 gallon Crystallizers, T316 SS, 5' dia. x 7' high, dished top, conical bottom.
7—560 gallon Crystallizers, T316 SS, 3'6" dia. x 7" high, dished top, conical bottom.
3—Worthington 160 Ton steam jet refrigeration units.
1—Pneumatic Conveyor System, approx. 1150' 10" dia. Aluminum Pipe.

TYPE 316 STAINLESS STEEL KETTLES

4—3,500 gal. jacketed kettles, 7' dia. x 12' high, T316 SS. 11/32" shell, dished heads, 11 turns SS coil, two-speed agitator, 40/20 HP-1750/500 RPM.
1—2,500 gal. 6' dia. x 12' high, T316 SS, horiz. still kettle.
3—1,000 gal. 5'6" dia. x 6' high, T316 SS, int. coils, turbine agit.

TYPE 316 STAINLESS STEEL TANKS

1—17,650 gal. 9' dia. x 36' long, T316 SS, ¼" shell, ⅜" heads w/coil.
2—7,500 gal. 10' dia. x 13' high, T316 SS, ½" shell, w/10 HP SE agit.
2—6,500 gal. 11' dia. x 7' high, T316 SS, 7/16" shell, ½" heads.
12—2,300 gal. 7' dia. x 8' high, T316 SS, ¼" shell, coils (some with agitator).
2—2,000 gal. 6'6" O.D. x 8' long, ¼" shell.
5—1,100 gal. 5'6" dia. x 6' high, T316 SS, w/coils, with agitator.
4—1,200 gal. 5' dia. x 7' high, dished top, 42" deep conical bottom (crystallizer tanks).
7—560 gal. 3'6" dia. x 7' high, ¼" dished top, 4' deep conical bottom.
55—Tanks and Pots from 10 gal. to 350 gal. sizes, vertical and horizontal, dished heads.

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1—1,450 sq. ft. condenser, stainless steel tubes, tube sheets, heads, and baffles.
1—1,200 sq. ft. condenser, stainless steel tube, steel shell.
14—750 & 800 sq. ft. stainless steel condensers, vertical, T316 SS tubes and heads.
9—Condensers, 356, 400, 410, and 550 sq. ft., T316 SS.
5—Calandrias, 140, 145, 150, 157, 250, 277 sq. ft., T316 SS.
11—Exchangers 64, 70, 75, 80, 100 sq. ft., T316 SS.
12—Exchangers 20, 30, 47, 50, 52, 54 sq. ft., T316 SS.
15—Cupro-Nickel & Copper exchangers, up to 1070 sq. ft.

MISCELLANEOUS EQUIPMENT

10,000—T316 SS pipe & tubing, 1", 2", 3", etc.
2,000—Valves, T316 SS, up to 10"
1—Otis elec. freight elevator, 5000# @ 75 FPM
40—Stainless steel pumps 1" to 6", 1 HP to 20 HP.
3—Steel columns: 48", 30", 20" dia.
2—St. St. bucket elevators, 62' and 45' high.
4—Stainless steel screw conveyors and chutes.
1—2,000 gal. aluminum tank, 6' dia. x 10' high, coils.
25—Stainless steel steam jet evactors and ejectors.
18—Separators, T316 SS, 22" x 8' overall depth, cone type.
1—Croll-Reynolds #21 jet vacuum air pump, capacity 50# per hour.
Also Stainless steel valves, pipes, steel tanks, pumps, stainless agitators, etc.

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1—Vulcan SS bubble cap column, 4' dia. x 28 plates
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1—Buflovak SS jacketed 300 gal. reactor with agitator and drive

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3—Steel & Alloy Tank Co. 100 gal. type 347 SS, pressure tanks, 250# pressure
1—Steel & Alloy Tank Co. 300 gal. type 347 SS, pressure tanks, 250# pressure
1—Steel & Alloy Tank Co. 125 gal. type 347 SS, jacketed autoclave, 250# internal and jacket pressures
1—Steel & Alloy Tank Co. 200 gal. type 347 SS, jacketed autoclave, 250# internal and jacket pressures
2—Blaw-Knox, 400 gal. steel jacketed autoclave, 570# internal pressure, 85# jacket
1—Columbia Engineering high pressure storage tank, 2400 gal., 265# working pressure
2—Struthers Wells type 316 SS jacketed reactors, 3500 gal., complete with coils, agitators and drives

DRYERS

4—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
1—Link Belt steel roto louver dryer, model 1003-30
1—Buflovak double drum dryer, 42" x 120"
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
1—Stokes double drum dryer, 5' x 12'
1—Louisville rotary steam tube dryer, 8' x 45'
1—Louisville SS rotary kiln, 30" x 28', complete
1—Louisville rotary dryer, 38" x 40', Type L
1—Louisville rotary steam tube dryer, 38" x 20'
1—Swenson 10' dia. SS spray dryer, complete

FILTERS

1—Sweetland #3 SS filter
1—Niagara SS filter, Model 510-28
1—Oliver horizontal filter, 3'
10—Shriver plate and frame filter presses, 12" to 42"
12—Sweetland #12 filters with 72 SS leaves
1—Shriver rubber lined filter press, 36" x 36"

MIXERS

1—Readco SS 25 gal. jacketed vacuum sigma blade double arm mixer
1—Patterson jacketed vacuum SS sigma blade mixer, 300 gal.
3—Robinson type 316 SS type jacketed heavy duty mixers, 400 gal.

THE GELB GIRL—JULY 1959

5—Baker Perkins double arm sigma blade mixers, 100 gal.
1—Patterson monel double cone blender, 4 cu. ft.
19—Robinson SS horizontal blenders, 255 cu. ft.
1—12' x 4', type 316 SS, Pug Mixer
1—Munson rotary blender, 40 cu. ft.

MISCELLANEOUS

1—Cleaver Brooks 500 HP package steam generator, 200#
1—Ames 300 HP steam generator, 150#
2—Heat Transfer Products steel bubble cap columns, 36" and 42" with 5 and 10 trays
1—Acme steel bubble cap column, 42" dia. with 10 trays
2—Patterson-Kelley steel heat exchangers, 1000 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson-Kelley steel heat exchanger, 427 sq. ft.
50—Steel heat exchangers from 10 sq. ft. to 400 sq. ft.
1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
4—Liberty SS 62 sq. ft. heat exchangers
1—Vulcan type 347 SS heat exchanger, 67 sq. ft.
1—Badger type 316 SS bubble cap column, 42" diam. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
3—Robins shaker screens, SS, 3' x 6'
1—Stokes Model DDS2 rotary tablet press
1—Struthers Wells SS calandria type evaporator, 365 sq. ft.
1—Swenson type 316 SS vacuum crystallizer, 2' x 12'
1—Swenson single effect evaporator, SS, 320 sq. ft.
1—Blaw-Knox steel distillation column, 36" x 40' with 24 trays, complete NEW
3—Williams type 316 SS hammermills, Model AK
1—Mikro Model 4th pulverizer
7—Milton Roy proportionating pumps, SS, 1½ GPH to 156 GPH

2—Sturtevant #7 dustless type 304 SS rotary batch blenders, NEW
8—Alco type 316 SS jacketed 3000 gal. reactors complete with agitators and drives
1—Feinc SS rotary string filter, 3' x 3', NEW
1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'

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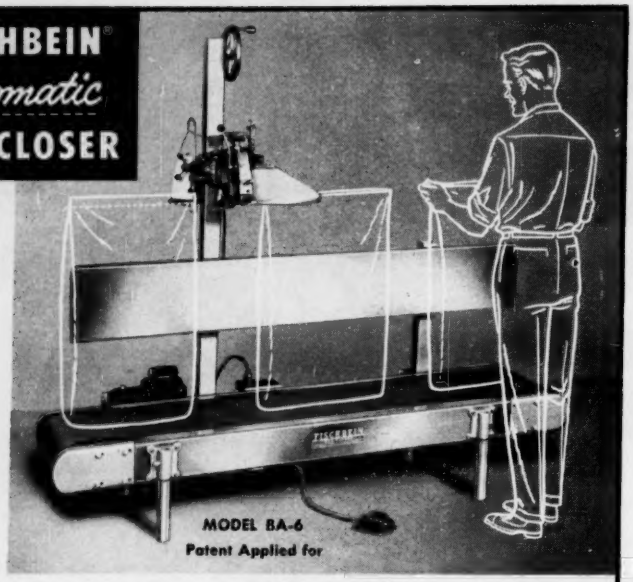

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- **Sews at rate of 30 feet per minute!**

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if it's done better with spray nozzles–

better best

it will be done **best** with SPRAYING SYSTEMS CO.

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HERE'S WHY:

1. You have a complete choice of **design types** to give the exact spray characteristics required.
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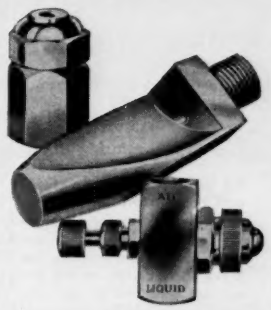
3. You have a complete choice of **materials** for chemical compatibility.

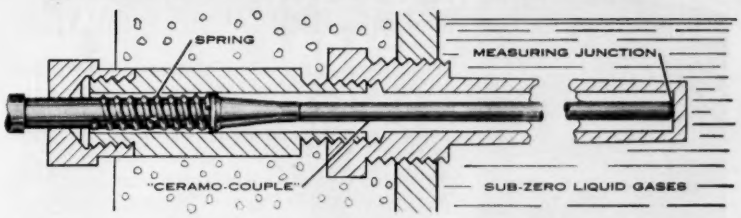
Your inquiry is invited.



SPRAYING SYSTEMS CO.
3275 Randolph Street
Bellwood, Ill.

For complete spray nozzle information write for Catalog 24.

Sub-Zero *Ceramo*-COUPLE Solves Condensation Problems



"Ceramo" versatility has also solved a key problem of *sub-zero temperature measurement*—condensation. Caused by wide temperature differences between ambient temperatures and the thermocouple measuring point, condensation can penetrate thermocouple insulation and short out conductors.

Overall Metal Sheathing of "Ceramo" thermocouple wire completely encloses conductors and ceramic insulation—shutting out moisture effectively. Sheathing itself is stainless steel or other corrosion-resistant material.

Spring-Loaded Construction of T-E's sub-zero probe holds contact point firmly against thermowell end—counteracting effects of expansion and contraction from temperature changes.

Applications—Liquid oxygen, nitrogen, ammonia and similar applications. Conductors are either Copper-Constantan or Chromel-Constantan for measuring temperatures as low as —320° F.

Write For Bulletin 52-E

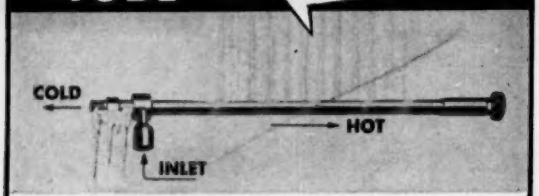
Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada:
THERMO ELECTRIC (Canada) LTD.,
Brampton, Ont.

FISHER®

HILSCH VORTEX TUBE

HOT AND COLD Running Air



Air pressure is introduced into the entry nozzle of the tube and hot air will leave at the long end of the tube. Cold air will exit out the short end.

We know this sounds impossible, but be assured if 60 psi air supply is connected to the Fisher Model SS-8 vortex tube, there will be a 60 degree drop in temperature of air coming out the cold end of the tube with a flow of 6 CFM. Temperature of air leaving tube is adjustable by inlet pressure and by throttling small needle valve at end of tube.

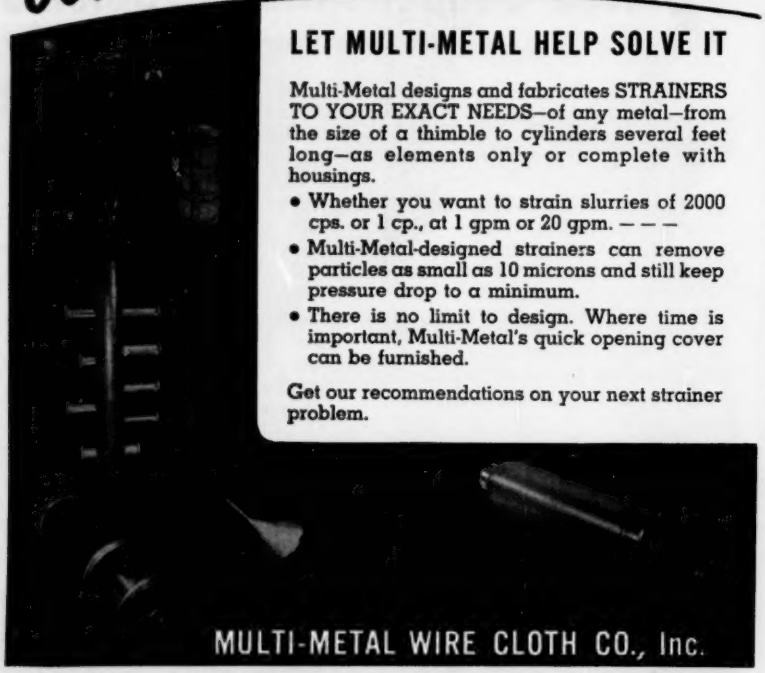
This is not a novelty or toy as many laboratories and industrial concerns have found the Fisher Vortex tube to be the answer to their small scale refrigeration or cooling requirement where conventional refrigerating would be too expensive and cumbersome.

Write for Bulletin K-8.

FISHER GOVERNOR COMPANY

Marshalltown, Iowa • Woodstock, Ontario

Got a STRAINER PROBLEM?



LET MULTI-METAL HELP SOLVE IT

Multi-Metal designs and fabricates STRAINERS TO YOUR EXACT NEEDS—of any metal—from the size of a thimble to cylinders several feet long—as elements only or complete with housings.

- Whether you want to strain slurries of 2000 cps. or 1 cp., at 1 gpm or 20 gpm. — — —
- Multi-Metal-designed strainers can remove particles as small as 10 microns and still keep pressure drop to a minimum.
- There is no limit to design. Where time is important, Multi-Metal's quick opening cover can be furnished.

Get our recommendations on your next strainer problem.

MULTI-METAL WIRE CLOTH CO., Inc.

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With free air the cooling medium you use the least water, evaporated in the air stream. You save the cost and pumping of large volumes of condensing water.

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This *air-cooled* condenser gives you more capacity than other types at a substantial saving of steam and power. Water supply, scaling treatment and disposal problems are eliminated.

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Maintenance expense is low. Balanced Wet Bulb Control provide precise, year 'round adjustment of capacity to load.

Constant temperature, uniform products and maximum production 12 months a year are assured. Unit capacities up to 15 million BTU.

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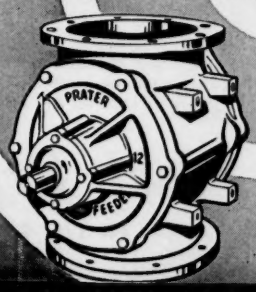

Write for Your Copy of "How to Select a Rotary Airlock Feeder" Bulletin P58

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CLAYMONT ALLOY STEEL PLATES

This giant steelman is the Image of CF&I—a major source of American industry's steel supply. CF&I manufactures a complete range of steel products for many uses—for instance, alloy steel plates produced at our Claymont, Delaware plant.

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Claymont alloy steel plates are regularly produced to the following specifications:

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CF&I-CLAYMONT PRODUCTS: Carbon Steel Plates · Alloy Steel Plates · CF&I Lectro-Clad Nickel Plated Steel Plates · Clay-Loy High Strength Low Alloy Steel Plates · Flanged and Dished Heads · Manhole Fittings and Covers · Fabricated Steel Plate Products Large Diameter API Pipe

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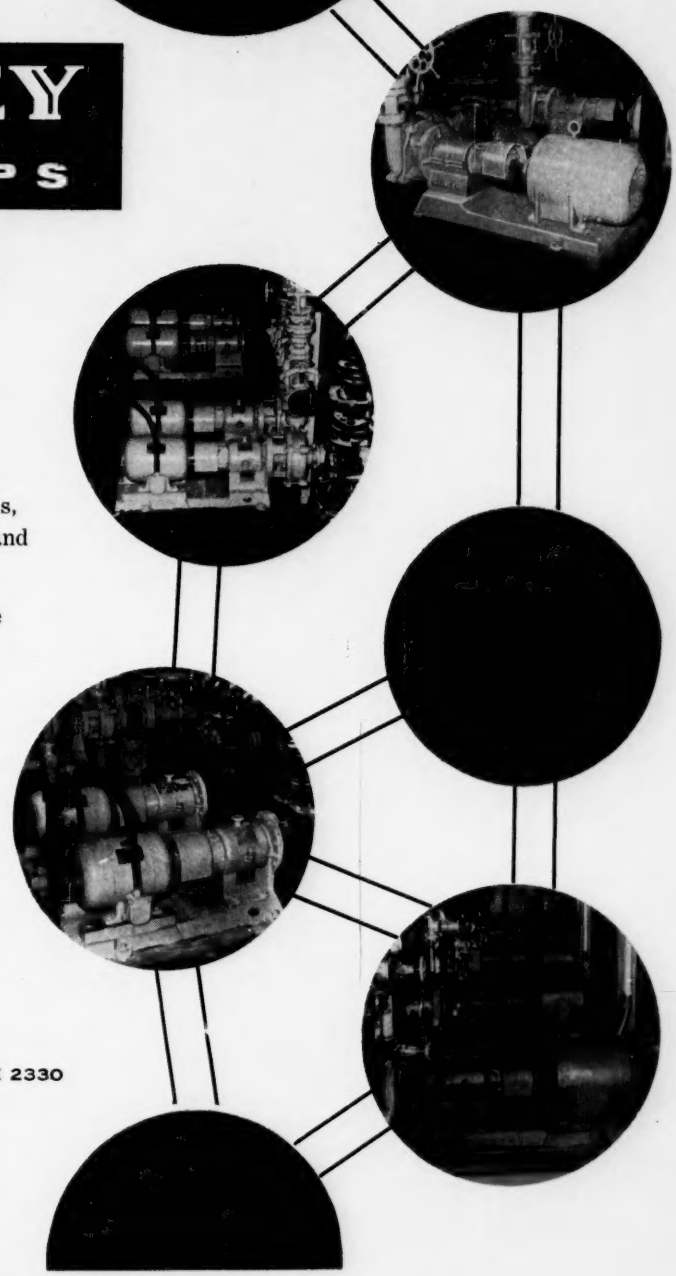
Every Installation

JOB ENGINEERED

WILFLEY
ACID PUMPS



Individual engineering on every application is standard practice with Wilfley. This personal attention to your specific requirements, plus Wilfley's day-in, day-out dependability, guarantee low cost pumping. Put a Wilfley Acid Pump to work... it will give you continuous, trouble free service, higher output and longer pump life.

Wilfley Acid Pumps are available with pumping parts of machinable alloys as well as plastic to meet every need in the handling of corrosives, hot liquids and other difficult solutions.

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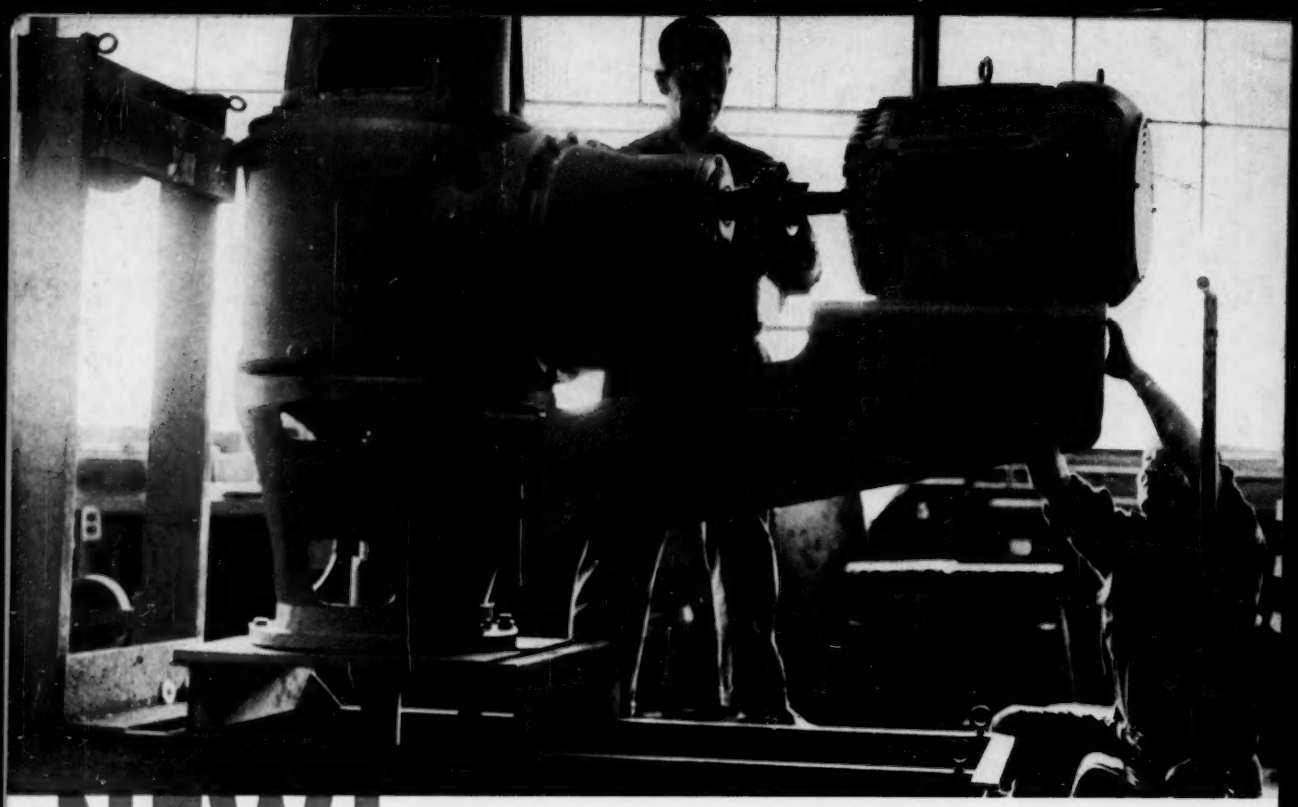


NEW! Fast delivery on mixers this big

There's no need to hold up production when you need a turbine-type fluid mixer as hefty as this one.

Instead of waiting months, you can now have one—or several—ready to put on your tanks *in a few weeks!*

In the new "5" Size LIGHTNIN Mixer you get time-saving standard construction previously available only in smaller sizes. Speed reducer and other component parts are *in stock* at the factory, ready to assemble to your order.

Ratings to 150 hp

Ratings range from 40 hp to 150 hp with double-reduction gearing, and from 10 to 50 hp with triple reduction.

You also get these time-proved LIGHTNIN Mixer advantages—*at lower cost than ever* for a mixer of this rating spread:

1. Interchangeable speeds, 16.5 to 280 rpm.
2. Simple, on-the-tank conversion from double to triple reduction should process requirements change.
3. Gearing protected from shaft shock loads by hollow-quill construction.
4. Positive splash lubrication.
5. Complete weatherproofing protection.

You can get the "5" Size LIGHTNIN Mixer in standard assemblies—and in special designs—for open or closed tanks; with stuffing box or with quickly replaceable LIGHTNIN rotary mechanical seal for pressure and vacuum mixing.

Here's what to do

For details, call your LIGHTNIN Mixer representative now. You'll find his name in Chemical Engineering Catalog. Or write us direct.

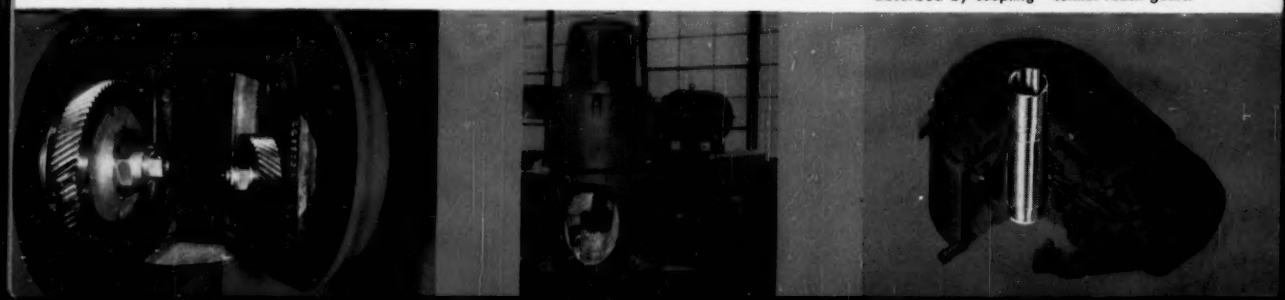
Lightnin® Mixers

MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 128-g Mt. Read Blvd., Rochester 3, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

CHANGE SPEED at any time. Change gears provide any of 15 standard AGMA speeds from 16.5 to 280 rpm. Nonstandard speeds, too.

CARTRIDGE SEAL, optional on pressure-tank units, eliminates stuffing-box maintenance and is easily replaced, if ever necessary, *without disturbing gearing or shaft alignment.*

MIXER SHAFT FLEXIBLY COUPLED TO SPEED REDUCER. Mixer shaft passes through hollow quill. Shaft and quill are connected only by a flexible coupling (not shown). Shock loads on shaft are absorbed by coupling—*cannot reach gears.*